JAN 25 1924 GENERAL LIBRARY UNIV. OF MICH.

The ELECTRICAL REVIEW

FOUNDED 1872

VOL. XCIV. No. 2407. [All Rights Reserved.] JANUARY 11, 1924. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] PRICE SIXPENCE.

LITHOLITE INSULATORS, Ltd.
55—57, Hackney Grove, London, E. 8.
'Phone and Telegrams: Dalston, 592, London.
FIREPROOF AND OTHER GRADES.
WIRELESS MOULDINGS.

The Acme Production Co., Ltd., *Electrical Specialities Manufacturers.* — **Automatic Flashers** — Britannia Works, Rolfe St. and Engine St., SMETHWICK, BIRMINGHAM.

WRIGHT Tel.: Motor.
A.C. and D.C. **MOTORS.**
WRIGHT MOTORS, Ltd., HALIFAX.

RESISTANCE MATERIALS
Asbestos Woven Resistance Grids. Resistance Cord. Resistance Wires & Tapes.
CRESSALL MANUFACTURING CO.,
Staniforth Street, BIRMINGHAM.
Telegrams: "Ohmic, Birmingham." Telephone: Central 3463.

LANTERN REFLECTOR, WATERTIGHT AND SHIPS' FITTINGS. **E.L.E.C., LTD.** with Anti-Vibrator Discs.
ENGINEERING & LIGHTING EQUIPMENT CO., LTD.,
Sphere Works, St. Albans, Herts.

AUTOMATIC REGULATORS AND—
See next announcement.
ISENTHAL & CO., LTD.,
Denzil Works, Willesden, N.W. 10.

SWITCHGEAR.
ERNEST F. MOY, LTD.,
Manufacturing Electrical Engineers and Government Contractors,
GREENLAND PLACE, CAMDEN TOWN, LONDON.

MICA & MICANITE
TAYLOR & PETTERS, LTD.,
40, Hatton Garden, London, E.C. 1.
'Phone: 4575 Central. See p. ii.

ALUMINIUM—STEEL FOR LONG-SPAN TRANSMISSION.
The British Aluminium Co., Ltd., 109, Queen Victoria St., London.

CHURTON SINGLE and POLYPHASE **MOTORS.**
T. HARDING CHURTON & CO., LTD.,
Atlas Works, Water Lane, LEEDS.

ELECTRIC MOTOR REPAIRS. **ARMATURES REWOUND.**
H. DUNN & SON,
Newington Causeway,
Tel.: Hop. 1167. LONDON, S.E. 1.

"EMPIRE"
HIGH-TENSION
LINE EQUIPMENT
POLE-TYPE SWITCHES, DISCONNECTING SWITCHES, CHOKE-COILS, LIGHTNING ARRESTERS, "EMPIRE" S. & C. FUSES UP TO 130,000 V.
ELECTRIC CONTROL, LTD, Glasgow.
Birmingham. Leeds. London. Manchester. Paris.

"KOPAN" (Regd.)
SYNTHETIC RESIN PRODUCTS
(Liquid and Solid).
THE BEST INSULATING & BINDING MATERIAL.
Write for Booklet.
THOMAS A. SCANLAN,
19-20, Water Lane, Gt. Tower St., E.C.3.

WESTERN-ELECTRIC
COMPANY, LIMITED.
Connaught House, Aldwych, W.C. 2.
Works: NORTH WOOLWICH, LONDON, E.
TELEPHONES & CABLES.
See Advertisement this week, Sup. 34.

JULIUS SAX
Specialists in
BELLS
and
Wall Plugs.
ESTABLISHED 1855.

WHITE
Electrical Instrument Co., Ltd.
2, 4 & 6, GLOUCESTER ST., CLERKENWELL, LONDON, E.C. 1.
Wire. Voltograph, London. Phone: City. 8660.

ELECTRIC MOTORS.
One, Two and Three-Phase.
BRITTAIN'S ELECTRIC MOTOR CO.
(Late Langdon-Davies Electric Motor Co.),
110, Cannon Street, London, E.C. 4.

INSULATING BEADS
Immediate Delivery.
HOLDER-HARRIDEN LTD., 1-2, Chiswell St., London, E.C.

Broadcasting Power.
See Sup. 8.

DERMATINE
JOINTING
PUMP VALVES
HOSE & TUBING
BELTING
Dermatine Co. Ltd. *Neate St., London, S.E. 5.*

SHUNT REGULATORS.
MOTOR STARTERS and all classes of Resistance Work.
STAR DELTA SWITCHES.
THE SOLENOID REGULATOR CO.,
HIGHGATE SQUARE, CAMP HILL,
Telephone: Midland 592 **BIRMINGHAM.** Telegrams: Solenoid, Birmingham.

COUNTRY HOUSE LIGHTING.
Send for particulars of our BEST Battery Set.
DELCO-LIGHT Co., The Hyde, Hendon, N.W. 9.
Tel. p.: Kingsbury 178. Telegs.: "Delco-Light, London."

MAVOR & COULSON, Ltd.,
GLASGOW.
MOTORS, DYNAMOS, SWITCHGEAR.

CONVEYORS & ELEVATORS.
Power Station, Coal & Ash Handling Plants.
FRASER & CHALMERS ENGINEERING WORKS,
(Proprietors: The General Electric Co., Ltd.)
ERITH, KENT. *London Office:* Magnet House, Kingsway, W.C. 2.
Associated with Robins Conveying Belt Co., of U.S.A.

CARSON'S
27, UPPER THAMES ST., E.C. 4.
Telegrams: "Ariadne, Cent. London." 'Phone: Central 6997.
INSULATORS.

FULLER'S UNITED ELECTRIC WORKS, LIMITED.
MANUFACTURERS OF
ACCUMULATORS BATTERIES
CABLES & CABLES EBONITE
WIRELESS APPARATUS CARBON BLACK
Head Office:
(General Sales Offices and Works).
WOODLAND WORKS, GROVE ROAD,
CHADWELL HEATH, ESSEX.

INGLEBY & Co., Ltd.
BEESTON,
LEEDS.
ELECTRIC MOTORS.

Advertisement Index, see page xl. *Official Notices, see Sup. 40.*

PRICE REDUCTION.

ALL "CANTIE" SWITCHES AND FUSES ARE NOW LISTED AS IN JUNE, 1914.

CANTIE SWITCH CO., LTD.
— LEIGHTON STREET —
NOTTINGHAM.

OUR
MOULDED INSULATORS
WILL
NOT MELT NOR **CRACK**
AT **300° F.**

USE—
"Belleroid" for Electrical Insulation and Low-Heat Conductivity.
"Bellerite" for Mechanical Goods and Low-Heat Conductivity.
"Bellerocks" Opaque to X-Rays.

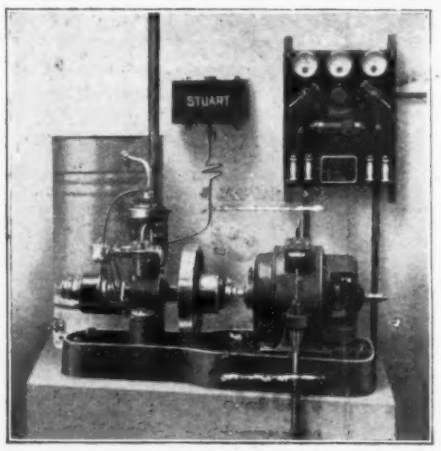
INSULATORS FOR
WIRELESS RECEIVING SETS
A SPECIALITY.
All British Made.

For Further Particulars and Prices apply to—

BARRETT & ELERS, LTD.,
Wallis Road,
HACKNEY WICK, E. 9.
Telephone: 887 EAST.
London Sales Agents:—
HARWELL, Ltd., 28, John St., Theobalds Road, W.C. 1.

MICA & MICANITE
INSULATORS FOR EVERY DESCRIPTION OF ELECTRICAL WORK.
Contractors for Air Board, War Office and Admiralty requirements.
CUTTING AND GAUGING OUR SPECIALITY.
BEST QUALITY MICA ONLY.

'PHONE—4575 CENTRAL.
TELEGRAMS—"MICAYLOR, LONDON."
TAYLOR & PETTERS, LTD.,
40, HATTON GARDEN,
LONDON, E.C. 1.
(The Oldest Established Mica House in the country.)
AND ALL BRITISH.



The ½ K.W. Plant

which is suitable for a house wired for 900 c.p. A pump for house water supply can be fitted. The Stuart plant is used by the Post Office, Marconi's Wireless Telegraph Co., Ltd., and other large users.

Exactly the same engine will be supplied to you in the ½ K.W. Plant.

Send for full Specification.

Other plants: 120 watts, 1½ and 3 K.W.

STUART TURNER, Ltd., Henley-on-Thames.
'Phone: 158.

SEND IT TO—

REPAIRS WINDS DESIGNS

COLLINS ELEC. LTD.,

115, CLERKENWELL ROAD, LONDON, E.C. 1. TEL: HOLBORN 212.

The

Electrical Review

VOL. XCIV. JANUARY 11, 1924. No. 2,407.

THE OLDEST ELECTRICAL PAPER. ESTABLISHED 1872.

Published every FRIDAY, Price 6d.

Technical Editor: A. H. ALLEN, M.I.E.E. *Joint Managing Directors:* G. H. ALABASTER. E. A. GATEHOUSE, M.I.E.E. A.M.INST.C.E. *Commercial Editor:* A. H. BRIDGE.

Manager and Secretary: E. S. MIDDLETON. *Chairman:* H. ALABASTER.

OFFICE: 4, LUDGATE HILL, LONDON, E.C.4.

Telegraphic Address: "AGEEKAY, CENT., LONDON," Code, A B C. Telephone Nos.: Central 8200 and 8261.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum. Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "Midland Bank, Newgate Street Branch."

LIST OF FOREIGN AGENTS (see first page "Official Notices").

Contents:

	PAGE
Official Publications	41
The Electrification of Norway	43
A U.S. View of German Competition	43
Scientific Lectures	43
Shanghai Accident	43
The Morwell Power Scheme, Australia (*illus.*)	44
Electric Accumulator Manufacture	45
Jottings by an Installation Engineer	46
Some Aspects of the Boiler-feed Question, by D. Wilson Jones	47
The Intellectual Equipment of an Engineer, by C. H. S. Tupholme	48
The Physical Society of London (*illus.*)	49
Correspondence—	
Electricity in Mines	51
Single-phase Induction Motors and the Starting Problem	51
Printing Telegraph Systems and Mechanisms	51
Electrical Apathy *v.* Gas Enterprise	51
Industrial Research	52
Delayed Deliveries	52
The Future of Radio Broadcasting	52
The Quantum Theory	53
Motor Starter Regulations	53
The "Model Engineer" Exhibition	53
Business Notes	54
Lighting and Power Notes	57
The North Metropolitan Electric Power Supply Company's Undertaking (*illus.*) (*concluded*)	59
Transformers for Very High Voltage Tests (*illus.*)	61
Tramway and Railway Notes	63
Radio Notes	63
Contracts Open and Closed	63
Forthcoming Events	64
Notes	65
Institution Notes	67
Our Personal Column	67
New Companies Registered	68
Official Returns of Electrical Companies	68
City Notes	69
Stocks and Shares	69
Market Quotations for Chemicals and Metals	70
The Westminster Salvage Plant (*illus.*)	71
The Control and Switching of High-pressure Distribution Systems, by P. V. Hunter (*illus.*)	72
The Electrical Industry in China	74
Metropolitan-Vickers Mining Switchgear (*illus.*)	75
Railway Electrification in Foreign Countries	77
A Turbine Explosion at Shanghai	79
Legal	79
Published Specifications	80
Contractors' Column	Advertisement page xxviii

Official Publications.

WE say without any fear of contradiction that the continued high prices of Government publications are standing directly in the path of the development of scientific discovery and research, are preventing the expansion of trade, and are obstructing the movement for securing better working conditions for, and the greater safety of, those who are engaged in factories and workshops, railways, mines, and so forth.

It is not our intention to discuss here why the selling prices of such productions are high—it is for experts and others directly associated with the printing and publishing trades to go into that important matter, and we believe that they have done so exhaustively. Government printing factories may be a costly luxury, necessary under some conditions, but unnecessary now—and putting the work out to competitive tender might reduce the cost—but that, as we say, is for other advisers to deal with. But the effect of the price charged to the public is unquestionably a matter which comes within our province, and it should concern everybody.

The price charged necessarily affects the circulation, or the number to be printed. If those responsible do not rightly evaluate the public interest in a certain document, they will produce a small number at a high price, and the probabilities are that they will have to throw away some of those. The larger the number printed the lower the price per paper with a readier sale. We know that this is all very elementary, but it seems to be important to emphasise the fact that some very simple circumstances are limiting the circulation of information prepared at great expense by Government officials for the benefit of the nation at large.

We are aware that a certain amount of information is prepared and printed which is of a quite specialised description, and can only appeal to a limited circle at once, being shelved for reference rather than immediately read; it is probably none the less essential for these reasons. But there is a great deal of other material which is prepared by men who exist as Government officials for no other purpose than to investigate questions relating to industrial operations and the safety and general well-being of the workers; to report on the course of trade in various oversea countries and indicate the prospects for manufacturers whose opera-

tions provide employment for millions of workers in the United Kingdom; or to record for the information of those concerned with scientific, educational, and cognate affairs what is of value to them and may enable them, as a result of the dissemination of their knowledge, to add to others' achievements.

We wish to deal with this subject in a very practical way. Pages might be filled with a disquisition on the benefits accruing from a freer circulation of scientific information from this country throughout the world; there were important reports prepared on the subject during the war when everybody was out to set something right, and some were out to set everything right. The world was supposed to be ignorant of British scientific achievement, the blame was duly allotted, and about the only thing that happened was an increase in the charges for postal transmission! Nowadays it is the people of these islands who are kept in ignorance, because under present-day conditions they will not or cannot pay the high prices charged for complete documents.

About nine years ago one of the finest industrial reports issued in this country was the annual statement of the chief and sub-inspectors of Factories and Workshops. That bulky blue book cost little more than a shilling, and it was full of information which any student of factory life could pore over with delight and instruction for many days. It enlightened the reader regarding efforts which were being made in some works to render life more bearable for men, women, and children; it revealed, too, the abominable conditions of life in other workshops, workrooms, basements, &c., and indicated the official measures that had been taken to secure improvements by means of warnings, prosecutions, and so forth, and suggested other and new means for securing that working conditions should improve simultaneously with the progress of civilisation. If this Blue Book were produced on the same scale to-day the charge to the public would be many times what it used to be.

Again, one of our contributors required a report on Trade Marks for the purpose of an article. The sum of over 30s. had to be paid for it, as compared with about three or four shillings for a somewhat similar document some years before. It will probably be news to our readers that many of the documents that we quote from in our pages are issued by public departments for the public information, but we have to purchase our own copies in order to be able to give this information the fuller publicity that it cannot secure under the official methods of distribution.

A point of considerable electrical interest was raised in our last issue. We have quoted at considerable length during the last two months from the reports of Mines Inspectors. The electrical matter that we have published was extracted from reports of considerable dimensions because the causes of electrical accidents in mines should be carefully examined by all interested in electrical equipment and working in our collieries. The discussion that has arisen in our "Correspondence" column shows that the wider the publicity that such reports can receive, the more general will be the acquaintance with the technical and operative requirements in order that accidents may be avoided. Our correspondent called for the selection of certain parts of these reports for separate publication for the use of those directly interested in them, but who did not want to buy the complete reports. The suggestion that we should do this sort of thing cannot be carried out, we fear, for the reports are the property of H.M. Stationery Office. All we can do is to give reasonably detailed extracts in our pages, but the idea that sectional pamphlets should be issued is a good one, especially coming at a time when complete documents are prohibitively costly. After all, the Government Stationery and Printing services are not in existence merely to print and offer certain things for sale. Those responsible ought to be able to judge the value of material to the public and to vary their production plans accordingly.

This brings us to another part of the general question of officially published documents of industrial and scientific interest, namely, that of their distribution. While it is important for the above-stated reasons that the prices of such reports and documents should be such as to ensure ready purchase by those likely to be interested in them, it is essential that there should be a generous and enterprising policy in their distribution among organisations, institutions, and individuals who from their specialised connection with scientific and industrial research and application should be furnished with copies free of charge. We are in complete agreement with our contemporary, *Nature*, which dealt with this subject in its leading article of December 29th. The writer mentions the generous and even lavish free distribution of scientific publications carried out by Government Departments of the United States of America, and adds, "one is tempted to speculate whether the activity and originality of research now apparent there may not be due in part to this sustained appeal to the scientific mind." On this side quite a different policy is pursued, and as an indication of the position taken up, we may say that all that even the Technical Press (ourselves, for example) is provided with is an official list every few days of new publications that are on sale so that we may know which to buy for the purpose of acquainting our readers with the nature of their contents. We gladly admit that there are notable exceptions, such as reports issued by the Department of Overseas Trade (and the Ministry of Transport) by, we believe, the desire of that Department which recognises that its representatives prepare reports on trade for the benefit of trade readers and not merely to lie in bundles at the Stationery Office.

According to *Nature*, even the meagre distribution of scientific literature by H.M. Government already in being is to be curtailed, and it rightly protests against this false notion of economy. It contrasts the former policy of freely circulating agricultural pamphlets, which we all doubtless remember, with the present difficulties which are placed in the way of the applicant for such. It further complains that some annual reports have shrunk from their former bulky proportions to dry skeletons; that scientific societies no longer receive copies of research publications in exchange for their own publications; that even the number of copies of a record of scientific work supplied to the author thereof is to be reduced to a ridiculous extent; and so on. Indeed, the position is most retrograde—almost hopeless as it appears to us.

The tendency of all this cheeseparing policy will be as *Nature* observes:—"Government researches will continue to be made, and the results laboriously gained by trained and expert workers will be printed at very considerable cost—and then consigned to oblivion in the cold storage chambers of H.M. Stationery Office or some other department." The whole attitude is "based upon a narrow idea of the importance of the spread of scientific knowledge—even upon a mistaken computation of the pecuniary value of science."

Summing up the points advanced, there should be a strong effort made by those specially concerned with such matters to reduce the cost of official publications so as to bring them within reach of everybody interested, and there should be a sweeping change made in either the policy of the Government or the official departmental attitude, or both, regarding the distribution of such papers and books.

Are we to allow discoveries made at great cost of brain power in the works, the college, the study, and in the laboratory by scientific and other original thinkers and experimenters, or information and data collected by students of industrial working conditions, or by compilers of statistical information regarding the course of trade at Home and overseas, to yield only a small fraction of their potential public advantage because of a little-minded attitude or of a mistaken kind of economy?

Knowledge as seed in the right soil will yield its hundredfold. Withhold it and we may rob the human race of its birthright. Heaven send us legislators with practical scientific wisdom—whoever they may be!

The Electrification of Norway.

A GENERAL report has now been presented to the Norwegian Government by the Commission which has been engaged for some time past on an examination of the question of the electrification of the country. In principle, the Commission has reached the conclusion that the supply of electricity should be built up by means of combinations of the towns and the counties, although it is considered that the State should make a financial contribution towards the expenditure in certain specified districts. In Finmark, however, it is suggested that the State should undertake the whole of the work. With regard to the conversion of railways to electric traction, the Commission expresses the opinion that each scheme ought to be investigated technically and economically. The problem has been examined by the Commission in regard to several lines mentioned in the report, and it is said that the work on these would involve an expenditure of 121,000,000 kroner, apart from the cost of extending existing stations so as to provide the power for the operation of these lines. Attention is further directed to the fact that hitherto the custom has been for electricity supply works to be built out of the proceeds of loans. In this connection it is pointed out that as the payment of interest on the loans plays a great part in the expenses of the works it is desirable to raise loans on the most favourable conditions possible. It is thought in principle that the establishment of a municipal bank would facilitate the raising of loans by the towns, and that such an institution could also meet the requirements of loans for electricity purposes. As a subsidiary matter, it is held to be possible to create an independent electricity bank which would be devoted solely to this object, based upon mortgages on the works, with a State guarantee against any losses, and the capital suggested ranges from 10,000,000 to 20,000,000 kr. Commenting upon the work of the Commission, a Norwegian newspaper states that it is of purely theoretical value at present, since the practical realisation of the plans in the near future is impossible.

A U.S. View of German Competition.

VARYING accounts have appeared in the Press for more than twelve months now regarding the power of German competition in foreign markets. On the one hand it has been stated that the low exchange value of the mark has enabled German manufacturers to undercut those of nearly every other foreign country. This situation, it is said, has been due also to the circumstance that German labour has been exceedingly cheap, the rate of wages paid having always lagged behind any increase in the cost of living due to the fall of the mark. It has frequently been questioned how far this advantage might have been annulled in the case of manufacturers who required raw materials from abroad and were compelled to expend considerably increasing quantities of marks in the purchase of the necessary foreign exchange. Those who raised that question have felt that inevitably an end would come to the juggling by which German traders have been able so often to replace their constantly falling currency by comparatively stable foreign values. Latterly, it is true, reports have been received to the effect that German prices have been approaching international level. For that reason and because of uncertain deliveries due to labour troubles and difficulties in obtaining raw material, German competition in many lines has, it is said, waned considerably. The American Consul at Stuttgart has been referring to this position; he says that in frequent instances the reports of German "low-exchange" competition have been of a character to discourage American manufacturers from making serious efforts in foreign markets. Information has now come to hand, he says, which shows that these reports have been exaggerated, for the trade returns covering recent years indicate that German exports of machinery since the Armistice have never equalled the pre-war volume.

During recent months the mark has depreciated to a point where it is of negligible value. The occupation of the Ruhr by the French, the reparations problems, and other factors, have interfered seriously with industry in Germany, with the result that during last summer the volume of German machinery exports was only about 10 per cent. of the trade in corresponding months of the previous year. The Consul quotes figures indicating that Germany is now scarcely a serious competitor in the industrial machinery trade abroad. It would seem, he adds, that the day is fast approaching when competition of this character will disappear. He considers, therefore, that manufacturers are justified in modifying their export plans accordingly. This, of course, is an American view. British electrical manufacturers know from practical experience that at present they have less to fear from German competition than from that put up by other producing countries. Unfortunately, all Britain's public utility works contracts do not meet the public eye, or the regard of some British people for the well-being of British industry and British workpeople would be seen to be lamentably poor.

Popular Lectures.

THE series of lectures which Sir William Bragg has delivered at the Royal Institution during the past fortnight has constituted a personal triumph for the author; rarely has such a series received so much attention in the lay Press, and the general accuracy of the reports is an eloquent testimony to the success with which the lecturer has treated of a difficult and abstruse subject in language which the layman can understand. Although the Christmas lectures are nominally addressed to a juvenile audience, they are probably appreciated even more by the adults who have the privilege of hearing them, and Sir William chose a subject with which he is not only entirely at home, but which is in great part entirely new and of absorbing interest to the uninitiated.

The value of such a demonstration to the cause of science can hardly be over-estimated; scientific research is largely dependent upon popular sympathy and support, and unless the public are informed with regard to its aims and its progress, their interest can be but lukewarm and apathetic. It is fortunate indeed that in Sir William Bragg, Fullerian Professor of Chemistry at the Royal Institution, there has been found a worthy successor to the long line of distinguished savants, including such popular teachers as Faraday, Tyndall, and Huxley, to whom the Institution is proud to have been a home.

The Shanghai Disaster.

OUR readers will share in our expression of deep regret to learn of the disastrous explosion of a steam turbine at the Shanghai electricity works, which resulted in the death of three British engineers and grave injury to a fourth, and will cordially sympathise with Mr. W. J. U. Aldridge, city electrical engineer, in the misfortune which has befallen his undertaking, as well as with the builders of the turbine. Up to now, we believe, apart from minor accidents in the very early days of the reaction turbine, Messrs. Parsons have held an unbroken record of immunity from such catastrophes; and indeed British turbine manufacturers as a whole have a most excellent reputation in this respect. To speculate on the cause of the breakdown at this stage would be futile; we must await the result of the inquiry which has been instituted into the circumstances.

The extraordinary violence of the explosion will be realised from a perusal of the report which appears on another page; fortunately the alternator was not seriously injured, nor were other generating sets involved, but much damage was done to the station. Nevertheless, the supply of electricity was completely restored within a few hours.

D

The Morwell Power Scheme, Australia.

THE SIEMENS E.H.P. CABLE SYSTEM.

THE first stage of the well-known Morwell brown coal power scheme in Victoria, Australia, which is nearing completion, involved the laying of some 50 miles of 3-core, paper-insulated, lead-covered, and armoured cable, having a section of 0.15 sq. in. per core and designed for a working pressure of 22,000 volts. Over 35 miles of cable have already been satisfactorily laid, tested, and placed in commission.

From the auxiliary power station at Newport B to

FIG. 1.—HAULING 22,000-V CABLE ACROSS THE CANAL AT MELBOURNE; END BEING LANDED.

the terminal house at Yarraville, the route follows the right bank of the River Yarra, and for more than half this section the trench, which is 7 ft. wide, runs through solid rock and, in places, is excavated to a depth of 12 ft.

For supplying electricity to Melbourne three cables are laid from Yarraville to the City Council's sub-station at Spencer Street and two others to the sub-

FIG. 2.—CABLE PASSING FROM WATER TO ROLLERS.

stations at Ascot and Royal Park; at Footscray all five cables cross the bed of the Maribynong River.

From this point the Spencer Street cables are carried two miles across the West Melbourne Marshes on a specially-constructed embankment to the Coal Canal Lagoon, across which lengths of submarine cable were floated with the aid of barrels and rafts hauled by power-driven winding gear. The whole of this operation was completed in one day, and the accompanying illustrations show the work in progress; similar methods were employed at the Maribynong River Crossing.

The whole of the 50 miles of 22,000-volt cable was manufactured, and its laying, jointing, and testing supervised by Messrs. Siemens Bros. & Co., Ltd., for the State Electricity Commission of Victoria. The cables were tested with 50,000 volts a.c. at the manufacturers' works at Woolwich and with 44,000 volts a.c. after laying and jointing.

Fig. 3 is a cross-sectional view of the e.h.p. cable

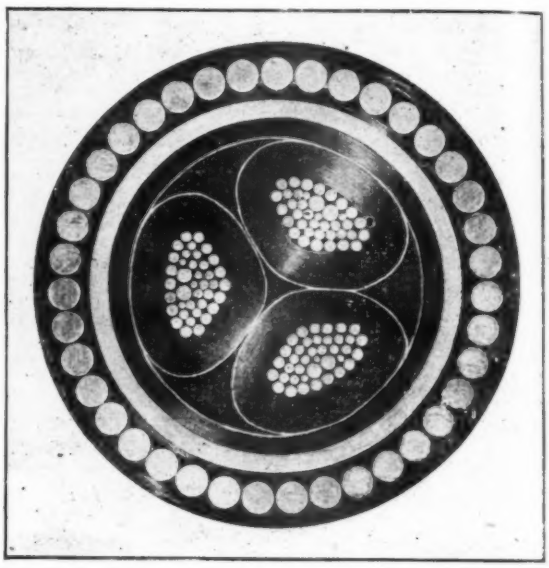


FIG. 3.—CROSS-SECTION OF 22,000-V CABLE.

used; the section applies to the whole 50 miles length, excepting those portions of the cable that cross the Coal Canal Lagoon and the Maribynong River, which lengths are provided with double armouring.

Patent Rights in Japan.—As a result of the recent earthquake at Tokio the whole of the registers and almost all the documents in the patent office were destroyed. The following are extracts from the laws promulgated with a view to avoiding detriment to those whom it may concern:—

Any right which arose from the decision of any administrative office within the area of the earthquake (such decision having been given prior to September 1st, 1923) that was to expire between that date and March 31st, 1924, shall be deemed to expire on the latter date, with the exception of such interests as were granted with a special order as to the period of their duration, which shall remain valid during the period specified in the order, provided that such period may be curtailed by an administrative office.

Any person who, prior to September 1st, 1923, applied for the prolongation of a patent right and has not yet been granted any decision, shall present to the Patent Office not later than December 31st, 1923, copies of the application and other documents related thereto, together with a written statement declaring the date of the original application. Any person who registered a patent or trade mark shall apply for the recovery of registration prior to October 31st, 1924, on which his right shall maintain the order in the original register. According to a provision in the Patent Law, a person who is not resident within the Empire of Japan cannot make an application to the Patent Office except through a representative who is resident in the Empire.—*Board of Trade Journal.*

Electric Baking is Economical.—Although it is generally conceded that electrically-heated ovens have many advantages over those heated by other means, many believe that the advantages of electric baking are not sufficient to off-set the differences in the relative costs of the fuels. A series of tests conducted recently in New York with a Westinghouse electric reel type baking oven and a gas oven of the same type showed that the electric oven baked more goods in a given time than a gas oven of equal shelf capacity; that the electric oven saved enough material by reducing shrinkage to outweigh the difference in fuel cost; and that products baked in the electric oven retained their moisture longer and, therefore, remained fresh and saleable for longer periods after coming from the oven.

Electric Accumulator Manufacture.

LEAD POISONING AS AN INDUSTRIAL DISEASE.

(COMMUNICATED.)

THERE are many industries in which the workers are liable to suffer interference with their health, and although in these modern times employers invariably take precautions to safeguard the health of their employés, it probably will never be possible altogether to eradicate cases of illness arising in industrial occupations.

Probably lead poisoning is one of the most insidious forms of poisoning met with in industrial work; although in recent years it has been more marked in workers engaged in electric accumulator manufacture, it is also found in other occupations, such as the smelting of metals, plumbing and soldering, white and red lead manufacture, pottery, and paint and colour works.

It is sometimes impossible to eliminate lead dust entirely from the atmosphere. Where factory conditions are consequently such that lead dust is regularly inhaled by a worker, it is mostly a matter of time before the accumulation of lead in the body passes the danger point, and until that stage is actually reached the worker may not realise that he is suffering from the effects of the poison. It is probably well-known to all lead workers that a small amount of lead can be taken into the system and passed out again by the bowels without doing any harm, and although it should be equally well-known that constipation causes accumulation of lead, a careless worker will fail to take steps that will give him relief, with the consequence that an attack of colic ensues, accompanied by severe griping pains. Effective and thorough purging will do a great deal of good, but there is a danger that the poisoning, if not checked, may soon spread to other parts of the body, amongst the first signs of this being that the worker becomes anaemic, pale, and tired. His muscles will also lose their power and waste away, and it may take several months for a cure to restore them to their former condition. In cases where the poisoning has been allowed to go on too long unchecked, the wastage of the muscles may become so great that permanent paralysis is the result. Sometimes lead is absorbed into the body and is retained without its presence being shown by any really acute attack such as colic, but when this occurs there is progressive degeneration of the blood vessels and serious effect on the kidneys, so that the general constitution of the worker is gradually impaired, and his health suffers accordingly.

The number of lead poisoning cases reported in occupations other than accumulator manufacture is comparatively small, but the number of poisoning cases reported in accumulator manufacture for Great Britain under the Factory and Workshop Act for the three months of June, July and August, 1923, was 48, as compared with 54 cases of lead poisoning in all other classes of industry added together. To those who are conversant with the many processes involved in accumulator manufacture where lead, lead oxides, and lead compounds are handled in large quantities, it is a matter of surprise that more cases of lead poisoning do not occur, as the first signs of lead poisoning are frequently neglected and are mistaken for only normal divergence from good health, and the result of the neglect is that poisoning in a more severe form inevitably follows. The 48 cases which were reported for June, July and August, 1923, show very clearly how necessary it is never to relax any of the regulations even in the slightest degree, as inquiry proved that the majority of these cases occurred in factories where there had been a sudden increase of orders, and the work had been carried on under conditions which, although not involving any actual breach of the health regulations, were unsatisfactory. It is very easy for unsatisfactory conditions to arise, as, even where lead processes are under careful supervision, it is difficult to avoid some lead being taken into the system, which is easily reached by way of the lungs.

Health regulations which are enforced by law have been issued for practically all occupations which are recognised as being dangerous to the health of the worker, and in the case of the manufacture of electric accumulators, the following is an extract from the Regulations made by the Secretary of State under the Factory and Workshops Act, 1901:—

WHEREAS the manufacture of electric accumulators has been certified, in pursuance of Section 79 of the Factory and Workshops Act of 1901, to be dangerous, the following extract from the regulations should serve as a warning that lead poisoning contracted during the manufacture of electric accumulators is an industrial disease.

In these regulations, lead process means pasting, lead-burning, or any work involving contact with dry compounds of lead.

The various processes of manufacture should be carried out in such a manner and under such conditions as to secure separation from one another, and from any other process, *viz.*:

(*a*) Manipulation of dry compounds of lead.
(*b*) Pasting.
(*c*) Formation and lead burning necessarily carried on forthwith.
(*d*) Melting-down of old plates.

Manipulation of dry compounds of lead in the mixing of the paste, or other processes, shall not be done, except in an apparatus so closed or so arranged with an exhaust draft as to prevent the escape of dust into the work room.

No woman, young person, or lad, shall be employed in the manipulation of dry compounds of lead or in pasting.

Every person employed in a lead process shall be examined once a month by the appointed surgeon, who shall have power to suspend from employment in any lead process.

No person after such suspension shall be employed in a lead process without written sanction by an appointed surgeon.

Overalls shall be provided for all persons employed in manipulating compounds of lead or in pasting, and the overalls shall be washed or renewed once a week.

A special cloak room is to be provided in which the workers can deposit their clothing put off during working hours.

No person shall be allowed to introduce, prepare, or partake of any food, drink, or tobacco in any room in which lead process is carried out.

A constant supply of hot water and cold water with a lavatory fitted with soap, nail brushes, towels, and at least one lavatory basin for every five persons employed in any lead process, shall be provided. Lavatories to be kept thoroughly cleaned, and to be supplied with clean towels once every day.

Ample time of not less than ten minutes, in addition to the regular meal times, must be allowed for the washing of each person who has been employed in the manipulation of dry compounds of lead, or in pasting.

Sufficient bath accommodation must be supplied for all persons engaged in the manipulation of dry compounds of lead, or in pasting, and hot and cold water laid on, with a sufficient supply of soap and towels.

The floors and benches of each work-room must be thoroughly cleansed daily, at a time when no other work is being carried on in the room.

All persons employed in lead processes shall present themselves at appointed times for examination by an appointed surgeon.

No person employed in any lead process should leave the premises or partake of meals without previously and carefully cleaning and washing his hands.

Every person employed in the manipulation of dry compounds of lead, or in pasting, should take a bath at least once a week.

Whilst some employers conform strictly to these regulations and do not go beyond them, there are others with progressive tendencies and broadminded views who extend their precautions considerably beyond the limit required by law, sometimes incurring considerable expense and other disadvantages in so doing.

Opinion is frequently divided as to how far the bene-

ficial effect upon their health is appreciated by the workers themselves, and it has often been proved that the best efforts of an employer in these health matters can be negatived by those workers who do not or will not follow out the instructions given to them. Cases have been known where a worker has of wilful and deliberate intent ignored the regulations safeguarding his health, and in some cases such a worker has been known to say that he has regarded the regulations as being something which wrongly interfered with his private freedom and therefore something which should be opposed in every possible way. Such a view in these enlightened days can only be attributed to sheer ignorance, but it is obvious that to make health regulations effective, co-operation is required from the employé. That this co-operation is not always to be found can be seen from the recorded cases of men who will not take the trouble to wash their hands thoroughly before taking their meals, even though ample working time is allowed by the employer for this purpose. Also the facilities provided by some employers for hot and cold water bathing by the workers are sometimes deliberately ignored, and cases have been known where men have entered the bathroom ostensibly to bath, but have not troubled to undress and use the bath provided for them, and have whiled away the time by surreptitious smoking. Unfortunately the employer has to bear the brunt of employés' negligence in these matters, as all cases of industrial poisoning are notifiable as accident cases, and are dealt with accordingly under the Workmen's Compensation Act.

Under such disregard of the regulations it is obviously possible for the workman to contract lead poisoning, but not sufficiently badly to disable him whilst engaged with one employer, and then to go to another employer in the same trade and in a short time become incapacitated owing to the poisoning developing. Employer number two naturally attempts to guard against such an occurrence, but it is not always possible to do so, and some measure of equity in these cases is usually obtained by the two employers sharing the liability between them by agreement.

A great deal depends on the care exercised by the employer's foreman in engaging new workers, as often a man who has successfully passed the examining doctor has been rejected for lead process work merely because, in the foreman's opinion, "he does not look right." A good foreman who has had years of experience in the accumulator industry can frequently make a sounder selection of new workers than is obtained from a medical examination, and such a foreman is invaluable to his employer, as cases have been known where, under similar conditions, men who have been passed by a doctor have been lead poisoned in a fortnight, whilst others have worked for months and even years without suffering in the slightest degree.

The abundant evidence which has been gathered in recent years shows that in works in which lead is handled there is the utmost danger to the workers if proper safeguards are not made for their good health. The number of cases above referred to, which were reported for three months in 1923, was considerably above the average which is usually found, and as in the general way the numbers are comparatively so small, it is a source of satisfaction to see from the available statistics that English makers of accumulators of repute are able to avoid any unduly large number of poisoning cases occurring, although accumulator manufacture is clearly an industry which would cause considerable illness to the workers engaged in it if not controlled by those regulations enforced by the makers and which experience has shown to be necessary and desirable.

Jottings by an Installation Engineer.

By "DICKIE BIRD."

ONE is frequently accused of having a cushy job; an idea which must be very prevalent judging by the numbers of applications that pour in when a position of installation engineer is advertised as being to let, with vacant possession.

The following disconnected collection of irresponsible notes is given in the fatuous hope that these gentlemen may be warned in time.

First and foremost, you are an outcast and pariah, and nobody loves you!

The mains department hate you for bringing them work and disturbing their lethargy.

The office staff loathe you for the same reason.

Your typist would as soon bite you as not when you interrupt her monologue—"Drop one, pick up one, drop—Dash the bell—Coming!" The chief looks at his salary and at your commission, and says sweet nothings about your nerve. (That you have a nerve can be safely assumed, provided that you have read the list of duties through, pondered over the accompanying salary and, despite these things, applied for the job!)

At the outset, the hoary idea of enlisting the services of the meter readers for propaganda or saleswork occurs to you. Remember *Punch's* advice to those about to marry, and turn your face to the wall. I once tried the idea by going meter reading in wet weather. (Of course, one has to have a great deal of influence to obtain a position of this kind.) By the time the first fifty meters had been read—or misread—the mains superintendent and the office staff were howling for my blood. I had two orders—one for a lamp and the other to clear out—and a chill, mental and physical.

Good installation engineers being very scarce, I was not sacked for the uproar that ensued when the accounts based on my readings were sent out. In fact, to such an extent is a really good man valued that my chief went to the trouble of ascribing the incorrect readings to an astigmatism which absolutely refused to take notice of any pointer inclined at a certain angle! Incidentally, I have not since had an opportunity of further research work in that direction.

House-to-house canvassing may then engage your attention. You will probably find this both laborious and degrading. If this does not deter you, the mains department will when you proudly exhibit a number of applications for supply to a street half a mile from the nearest cable. This *contretemps* can be avoided by inquiry as to the mains' positions before setting out, but mains engineers are case-hardened and, if you are new to the district, will think nothing of persuading you to canvass a district well outside the boundaries of the supply authority's area.

Opinions vary as to the time to call at the selected house. Call in the afternoon and you may see the mistress of the house; call in the evening and you see the master. By all means call in the afternoon. In the first place, the evenings are your own time—theoretically—and in the second place, being an installation engineer, you will not have sufficient intelligence to argue the point with the male. The application form duly signed, and you chance to meet the husband, smile at him and tell him a funny story in the interests of self-preservation. Should he hail from over the Border, cut out the funny story and make a dash for it, on the principle that, to make a Scotchman happy in his old age you must tell him a funny story in his youth.

Reference has been made to the antagonism of your

fellows. Now, you have a large number of varied duties to perform, and perfect inter-departmental peace is necessary to allow of these duties being carried out in a satisfactory manner. It is therefore up to you to see that harmonious relationships are established and maintained. To this end it is advisable to give the other parties as much assistance in carrying out their duties as possible. Perhaps a little advice might be helpful to the mains department, for example. A sample is given below which can be adapted to meet existing conditions, and which will, I trust, give as much satisfaction as may reasonably be expected.

"A HELPING HAND FOR MAINS MERCHANTS."

Don't worry if you are expected to commence work at 8.30 a.m.; it is only done to annoy you.

Don't worry about technical matters; come to the installation department. The brain fag is not so great.

Don't carry heavy meters. We are, as always, at your disposal.

Don't lay cable without a kerbstone near. It may be lost.

Don't worry about bashing flagstones. What is the surveyor for?

Don't worry about tests. As usual, think of a number and double it.

Don't damage the wattless component. Spare parts are unobtainable.

Don't trouble to keep records. They only go bad, and nobody cares, anyway.

Don't pass store orders in writing. It is too businesslike and *infra dig.* for technicians.

Don't, when seeking faults, swear at juvenile onlookers. They don't get much free amusement.

DON'T, above all, WORK. The Installation Department is still in existence.

Of course, whether it is likely to remain in existence for long after you have posted a score or so of pamphlets on the above lines all over the works, is your picnic.

I think enough has been said to give pause to any prospective candidate. There only remains the pointing out of an infinitely easier alternative: get a mains superintendent's job!

Some Aspects of the Boiler Feed Question.

By D. WILSON JONES.

Up to the present time sufficient attention has not been given to the necessity of providing absolutely pure boiler-feed water. The tendency of present-day practice is to utilise increasingly high boiler working pressures, and consequently more thought must be given to the adequate provision of chemically pure, gas-free feed water.

As there is little doubt that the life of a steam boiler depends in all probability more on the quality of the water with which it is fed than on anything else, there appears to be no reason why its life should not be prolonged materially, as the defects to which it is liable (excepting those which are attributable to the impure feed water) may be almost entirely obviated without much difficulty.

To the steam user with a large battery of boilers, impure water entails an enormous annual outlay on maintenance and upkeep, not to mention the financial loss and inconvenience occasioned by the fact that each boiler in turn calls for overhauling and scaling. The use of a suitable feed water is of the utmost importance.

At this stage it should be pointed out that on account of its complexity, boiler-feed chemistry has been severely left alone by the ordinary engineer. Furthermore, those who have made a study of the subject have diverse opinions regarding the reactions set up in boilers. With regard to corrosive action, this defect has not yet been conclusively traced out.

Natural waters are all more or less impure, on account of the powerful solvent action of the water. In the form of rain, mist, dew, &c., it absorbs certain gases and impurities from the atmosphere. The most important gas absorbed is carbonic acid (CO_2), which is present in the atmosphere to the extent of approximately four parts by volume in every ten thousand. Water so charged is capable of dissolving certain salts of lime and magnesia, and, in consequence, when the water reaches the ground, the more soluble salts with which it comes in contact are dissolved during its percolation through the earth. Of the salts that render water "hard" the most important are the sulphates and carbonates of lime and magnesia.

The adverse effects of impure feed water cannot be too fully emphasised. In consequence, the whole system suffers, and boiler and economiser tubes, turbine blading, and also steam valves show unmistakable signs of its ravages. The effect is more particularly noticeable in the highly efficient water-tube boilers which are so rapidly gaining favour in land installations.

It is worthy of notice that in the Navy for many years particular attention has been given to the feed question, with the result that naval boilers have been practically immune from trouble on this score.

Even the utilisation of the most suitable sources of natural supply, which have not been treated, does not give freedom from trouble, on account of the accumulation of relatively small quantities of impurities. In many cases excessive blowing-down is resorted to, but this is to be deprecated, as it is a source of considerable loss of heat units, with the consequent lowering of the boiler efficiency, not to mention the strain imposed on the boiler by the introduction of a large quantity of comparatively cool water to bring the level up again to normal.

The method of treating water by the softening process is to be condemned, as it does not get to the root of the trouble, and, moreover, it is complicated and calls for very careful mixing of the chemical reagents on account of the great variation in the constituents of any particular source of water supply, due to varying climatic conditions. This has been amply demonstrated by analyses of samples taken from the same source at different seasons of the year. In many cases more harm than good is done by using this method of treatment, especially in the hands of those who are not fully conversant with the actual requirements, which can only be accurately determined by a fully-qualified chemist. The retention of such a chemist is a source of considerable expense, which has to be debited to this system. Some water-softening systems also have the great disadvantage that the feed water under treatment is exposed to the air and consequently absorbs the gases in the atmosphere, and by so doing renders itself an ideal agent to set up corrosion.

Besides the method already mentioned, there are a great many boiler compositions on the market, which the vendors supply in many cases, without concerning themselves with the nature of the water to be treated, but making the bold statement that their preparation is suitable for all feed waters. On investigation some of these preparations have been found to contain up to 98 per cent. of water.

Many engineers resort to the use of water from the town mains for feeding their boilers; not only is this

costly, but here, again, the water is not entirely free from scale-forming matter, and it also contains dissolved gases.

From this it will be seen that none of these methods fully meets the case. The most feasible way of overcoming the difficulty is by the direct removal of the cause, which may be readily and easily accomplished by resorting to distillation. Evaporators have made such strides that at least one make on the market to-day is able to work continuously, treating pernicious samples of water and producing therefrom a chemically pure, gas-free feed water at 212 deg. F., without the slightest scale forming on the heating surfaces; the live steam fed to the plant is returned to the boilers as feed water at 212 deg. F., so that actually the process is carried out by the utilisation of the latent heat of the steam. This plant has a very high efficiency, being able to produce from 3 to 5½ lb. of gained distilled water per pound of live steam fed to the apparatus. This result is largely due to full use being made of the steam of ebullition arising from the water under treatment, as well as the transference of heat taking place under the most favourable conditions. Special steps are also taken to avoid all chance of concentration taking place in the plant, and to remove gases that cannot be condensed. The operation of this plant being automatic, very little attention is necessary other than casual supervision.

A point to be considered in the installation of an evaporating system is the production of the requisite feed make-up by the use of the minimum amount of live steam.

In the marine-type evaporator for the production of 5 per cent. feed make-up, it is necessary to set aside no less than 6½ per cent. of the main boiler evaporation as against approximately 1 per cent. in the case of the highly efficient plant referred to. On a year's working the highly efficient plant will of necessity show a very considerable saving over its competitors, and at the same time will leave a bigger percentage of steam available for the turbines, &c.

It is also advisable to provide a suitable means for degassing the main condensate. This may most easily be accomplished by the installation of a direct-contact heater supplied with bled steam from the turbines or other convenient source, with a connection to the condenser fitted with a regulating valve which can be adjusted so that the degassing can take place at about 160 deg. F.

Actually what is necessary for degassing to take place is simultaneously to lower the pressure and raise the temperature of the water under treatment, thereby liberating the air, which may be removed to the condenser. By so doing, the feed is rendered non-corrosive and the water is available at a high temperature for pumping directly to the boilers without coming in contact with the atmosphere.

It is strongly advisable to arrange for a closed feed system wherever possible, and, by so doing, to obviate all possible chance of corrosion due to absorbed gases. By the utilisation of a highly efficient evaporator, in conjunction with a degasser and feed heater, the engineer is able to have high-temperature feed water in an ideal form at a minimum cost, and at the same time utilise a source of crude-water supply which will probably cost nothing, to the utmost advantage, whilst increasing his boiler efficiency to the maximum and reducing upkeep charges to the minimum.

The Intellectual Equipment of an Engineer.

By C. H. S. TUPHOLME.

Of what should the training of an electrical engineer consist? What must he know when he sets out from his university or technical college to take his place in the engineering world? When asking oneself this question it is well to remember that engineering is a widening science, that the old methods of training an engineer will not do, and that those establishments which educate the young engineer and prepare him for future utility to the State must keep abreast of modern development and tendencies not only towards specialisation, but also towards the enlargement of the engineer's scope or service to the public.

It is of course obvious that every engineer must be thoroughly trained in the application of scientific theory and book learning to the problems of every-day engineering operations. That is to say, his book learning must be thorough, and, when he is finally turned out of his educational institution as a product ready for the market, he must possess at the very least an elementary knowledge of the application of his theories. Here is where he differs from the scientist. The scientist is primed with book learning and can apply his learning to laboratory experiment, but beyond this he does not go. He is concerned only with the basic facts and theories and with the development of new designs and processes. It is the engineer's job to adapt and mould these theories and developments in the design of a motor, the laying of a cable, or the maintenance of a generating station.

This knowledge of the specialised branch of his profession is naturally the most important to the young engineer, and, to my mind, the next essential in his training is a sound grounding in the fundamental facts and fallacies of economics. He must understand such forces as demand and supply, production, rates and methods of payment, markets and such developments of these forces as hours of work, industrial fatigue, incentive, and the effect of these factors on production.

As a corollary to this the engineer should be thoroughly acquainted with costs of materials, costs of production, and operating expenses. In other words, he must know just how to do for one shilling what the scientist or the man without a knowledge of costs could do for two shillings. True, the engineer serves his employer and his State by improving the industrial equipment of his country, but he must bear in mind always that the question of cost, especially in these days, is the deciding factor of any project. He must seek means to improve industrial equipment at lower costs, thus striving towards the maximum efficiency at the minimum expense.

Without an understanding of this commercial aspect of his work, the engineer is no more than a scientist with a smattering of practical ability. His job is not only to devise ways and means of improving and adding to the resources of his employer, whether private, company, or State, but also to save his money.

These two aspects of the engineer's training are essential to his efficiency, but there are others which will always stand him in good stead in any position he may be called upon to fill.

Engineers, so I am told, are notoriously poor writers. That is to say not illegible, but illogical, writers. This was the case a decade or so back, and though engineers have improved their writing qualities there is still a large number who cannot put down their thoughts on paper in connected fashion. "Give me a drawing pen, not a fountain pen," says the engineer. This won't do. Every young engineer must cultivate the ability to write as every educated man should be able to do.

The engineer is usually an indifferent speaker and often a poor thinker. One has only to listen to some of the engineering papers and discussions to realise these two facts. It is not practicable or desirable to introduce journalism, elocution, and logic into the engineer's university curriculum, but every young engineer should familiarise himself with the elements of writing, speaking, and thinking correctly. A little practice in his own technical association or institution will soon put him right.

Lastly, the engineer should know how and where he can improve and rub up his theory, which in the best of us becomes rusty after a time. Libraries should be thoroughly familiar to him, and he should know exactly how to locate a subject, a book, and a formula in that book. This is a great asset and cannot be overcultivated. He must also know which of the technical journals are of value to him and just how to use the information in those journals, either by binding or by clipping.

Naturally, all these qualifications cannot be provided for by technical institutions, though they could, no doubt, do much to improve the intellectual equipment of the graduated engineer. The majority of these qualities can only be acquired and developed by observing and reading thoroughly and widely, and in this way only can the young engineer hope to fit himself for the pinnacle of the greatest profession in the world.

The Physical Society of London.

ANNUAL EXHIBITION OF INSTRUMENTS.

THE fourteenth annual exhibition of electrical, optical, and other physical apparatus of the Physical Society of London, and the Optical Society, was held at the Imperial College of Science on January 2nd and 3rd. A very large collection of exhibits was arranged by more than fifty leading firms, and although the majority of the apparatus have already been described by us, there were many new instruments and appliances displayed. We give a brief description below of some of the principal features of the exhibition.

H.M. Signal School, Portsmouth.

The exhibit of this establishment consisted of the component parts of a silica transmitting valve of a type similar to that described by Mr. H. Morris Airey before the Institution of Electrical Engineers in March last. The valve is designed so that a minimum amount of oxy-hydrogen flame-work has to be done on the silica after the metal parts have been inserted. Nitrogen is passed through the valve to prevent the formation of oxides, and the valve is baked to 800 deg. C. with hydrogen to clean the metals thoroughly. This reduces the time required for bombardment considerably. The valve is then baked to 110 deg. C. while being exhausted, and, before sealing off the valve from the pumping set, the metal parts are brought to a bright heat (from 1,300 to 1,400 deg. C.) by bombardment. The grid is bombarded to 6 kW and the anode to 24 kW. As at present designed, the valve can supply 21 kW to an aerial from an input of about 33 kW at 10,000-12,000 anode volts. The filament can be renewed at a cost which is very low compared with the cost of a new valve. The valve is still in the experimental stage.

Igranic Electric Co., Ltd.

The exhibits of this firm consisted wholly of accessories for use in radio work, including a large number of the well-known honeycomb coils. For use where the presence of an operator's hand introduces unwanted capacity, the firm has made a vernier friction pencil. This is illustrated in fig. 1. It consists, as will be seen, of a rod of ebonite somewhat similar to a fountain pen, and an ordinary pen clip is fitted to it. To enable the pencil to be employed, a hole is drilled near the edge of the dial, and a bush, supplied with the pencil, is inserted in it. Vernier adjustment is obtained by placing the end of the pencil in the hole so that the rubber ring engages with the bevelled face of the dials, and rotating it. By sliding the clip attachment to the end of the pencil, the device may be employed as an anti-capacity adjuster; for this purpose it is necessary to drill two holes, one in the centre of the knob, for the pin, and the other a little out of centre for the ball of the clip. The firm also showed small electric soldering irons suitable for radio work. These are well finished, and the parts are standardised, making replacement simple. Another device exhibited was the "Vernob" adjuster for condensers, &c., which by means of one knob gives both coarse and vernier adjustment. Other exhibits were intervalve transformers, filament rheostats (including special types for dull-emitter valves), battery potentiometers, &c.

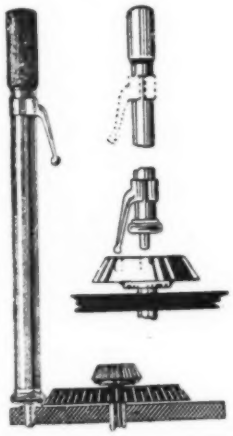


FIG. 1.—VERNIER ADJUSTMENT PENCIL.

Marconi's Wireless Telegraph Co., Ltd.

The principal exhibit of this company was a high-speed telegraph recorder designed by Dr. W. W. McLachlan, M.I.E.E. This device consists essentially of a drum of Swedish iron, with an annular recess in which are situated coils of fine wire, the ends of the coils being connected to corresponding slip rings. The periphery of the drum is faced with cast-iron rings, which are machined to run true to 0.0001 in. A small steel shoe rides on the rings, and side play is prevented by a brass guide-piece with a projection which fits into the annular recess. At each end of the guide-piece a hook is formed, and one of the hooks is connected by a light rod to a duralumin lever pivoted to turn in a horizontal plane. A silver siphon passes through the lever from an inkwell overhead, and rests lightly on a moving paper tape. To the other side of the lever is attached a strong spring, the tension of which can be varied, while the remaining hook is attached to a light spring which prevents the shoe from rocking on the drum. The drum is revolved by a small electric motor, and when a current flows in one of the coils the shoe is attracted to the drum, and a large pull is required to prevent the relative motion of the two. This pull is used to

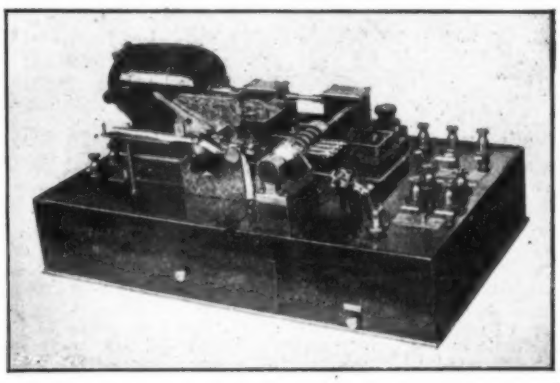


FIG. 2.—THE MARCONI-MCLACHLAN HIGH-SPEED TELEGRAPH RECORDER.

actuate the siphon lever mechanism so that the transverse movement over the paper tape inscribes the incoming message as a series of rectangles, the tops of which represent the dots and dashes of the Morse code. The tangential pull on the shoe is many times that calculated from the formula $\mu B^2 A/8\pi$, where μ is the coefficient of friction, B is the flux density at the shoe contact, and A is the area of contact. The ratio of the actual to the calculated pull depends on the flux density, and has a maximum value of about 80 for steel or cast iron. Owing to this phenomenon, which gives amplification, and to the fact that there is no air gap in the magnetic circuit through the shoe, the instrument is extremely sensitive, and will work at a speed of 150 words a minute with a current of 25 micro-amperes. It will work in a thermionic valve circuit, and for radio-telegraphy it is fitted with relay contacts, so that incoming messages in Morse may be relayed to a printing or other machine direct. The machine is illustrated in fig. 2.

The "Otophone," which was demonstrated at the stand, is an instrument to assist persons with defective hearing. It is contained in a neat and conveniently-carried case (see fig. 3), and consists of a two-valve voice amplifier, together with an earpiece and flex. A microphone with negligible free vibration is used, and thus good acoustical qualities are ensured. The microphone current passes through one winding of a transformer, the secondary of which is connected to the grid

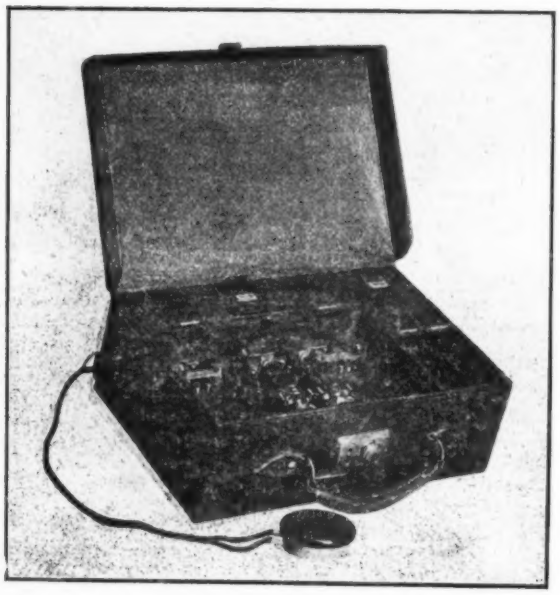


FIG. 3.—THE MARCONI "OTOPHONE."

of the first three-electrode valve. In the anode circuit of this valve is the primary winding of another transformer, the secondary of which is connected to the grid of the second three-electrode valve. The telephones are in the anode circuit of this valve. Across the grid windings of these transformers resistances of three values can be connected in turn, and the deaf person can thereby control the strength of the speech coming to his ears. Dull-emitter valves are employed.

Mullard Radio Valve Co., Ltd.

This firm's chief exhibit was a "Holweck" molecular pump, which is employed for exhausting the bulbs of thermionic valves. This is a development of the Gaede pump which was suggested by the kinetic theory of gases. According to this theory, the molecules are moving at very high speeds and colliding with each other and with the sides of the vessel in which they are contained. In a stationary vessel the velocity of rebound from the walls is the same as that of impact. If, however, a gas molecule rebounds from a moving mass its rebound velocity is altered, and the velocity of the molecule in the direction of the moving mass is increased. This fact is used in molecular pumps to increase the velocity of the gas molecules in a particular direction. As every collision with the moving mass imparts motion in the desired direction, it is essential to have many collisions with it, and to secure this end the distance between the moving mass and the other boundary of the gas space is made very small. In the "Holweck" pump the moving mass is a rapidly rotating cylinder (D in fig. 4), and the fixed boundaries of the gas space are formed by a shallow spiral M cut in a fixed cylinder C just large enough to take the rotating cylinder. Actually two spirals are cut, one right-handed and the other left-handed, and the motion of the drum is such that gas in the spiral space is driven from the centre to the ends molecules in the spiral space are driven from the centre to the ends of the drum where they enter a space P connected with a "rough" or preparatory pump. The centre space MM is connected through a tube S to the vessel to be evacuated. By this ingenious design the rough vacuum pump maintains a good vacuum at the place where the apparatus is jointed together, and risk of leakage from the atmosphere to the high vacuum side is made almost impossible. The cylinder D rotates in ball bearings, and is driven by an induction motor, whose rotor H is on the cylinder shaft and is in the rough vacuum space, and whose stator J is outside the pump. The windings of the stator are fed with two-phase alternating current, which is supplied by a small rotary converter fed from 110-V d.c. mains. The working speed is 4,500 r.p.m. So efficient is the balance and so free from friction are

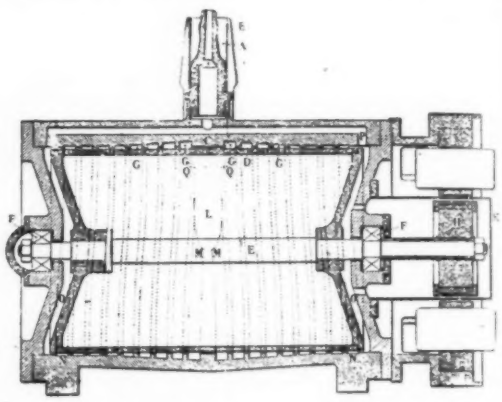


FIG. 4.—THE "HOLWECK" MOLECULAR PUMP.

the bearings that only 10 watts is consumed in maintaining this speed, and with a good vacuum the cylinder continues to run for ¾ hour under its own momentum.

Apart from the pump, the company had a large display of radio valves of many types. Included in this were four patterns of dull-emitter valves for various applications; a 2.5-kW transmitting valve and a 4-kW rectifying valve were shown. Both of these valves are constructed with silica envelopes. The filaments of the valves are designed to give a total emission of 3 amps. The transmitting valve deals with an input of 10 kW. In addition, there were shown receiving and amplifying valves, &c.

John J. Griffin & Sons, Ltd.

An interesting laboratory appliance shown by this firm was the "Fletcher" micro-furnace, an apparatus for the rapid qualitative analysis of metals, ores, and metallic salts. The furnace consists of a carbon rod between two electrical terminals upon which the sample under investigation is placed and covered with a small glass plate. Upon the passage of the current the material is sublimated and deposited upon the plate, and by comparison with a chart or from experience the principal constituents can be ascertained. Another leading feature of the stand was a block calorimeter designed by Prof. C. V. Boys. In this instrument the whole of the metallic water-containing structure is replaced by a single block of "Onazote" with all the water passages and spaces formed by moulding, so that when the block leaves the mould it is finished. A lid and base are similarly made of the same material. "Onazote" is an impervious expanding hard-rubber compound having the structure of a fine foam, all the cells being closed. It may be made with a density of one-twentieth of that of water, and of all materials it is said to be the most perfect non-conductor of heat known. The inlet water circulates in an annular passage round the cold thermometer chamber before entering the chamber. Similarly it circulates in an annular passage round the hot water thermometer chamber, and the upper part of the heat interchanger after leaving the hot thermometer chamber. The lid and base give further protection against loss or interference from above or below. In the example exhibited, a lead interchanger as used with Prof. Boys's recording calorimeter was provided, but should the block calorimeter be used for other purposes, *e.g.*, the heat developed by an electric current, then the lead interchanger would be replaced by an appropriate construction. A feature of the block calorimeter is the provision of means for regulating the temperature of the air used for combustion, so that it may have the same temperature as the gases leaving the instrument, at least within 0.1 deg. C. This avoids the necessity for correction due to change of temperature of these gases. The space below the block is boxed in and divided into two compartments. The warmed water leaves the instrument through one of the compartments, and the air for combustion, which is drawn from the other, can, by the use of sliding valves, be drawn from outside or from the warmer chamber. In this way its temperature may be adjusted. Other things shown were gas meters, bomb calorimeters, an optical bench, &c.

(To be continued.)

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

Electricity in Mines.

Your correspondent "M. E. B." appears to be interested in the safe application of electricity to mining, and asks for information from those directly connected with the industry regarding the impression conveyed to his mind that the underground electrician is given a free hand and the machine man is allowed to interfere with the apparatus working at 500 volts a.c.

As one directly concerned in the maintenance of a large mining electrical installation consisting of high- and low-pressure supply, a large number of electrically-driven coal-cutters operating at 600 volts being part of the installation, I may say that in my own case the electrician is given a free hand as far as his duties permit him, he being appointed in writing in accordance with the Coal Mines Regulations, his duties also being defined in writing. Enclosed is a copy of the permit issued to such men.

With regard to the machine-men, these persons are appointed as operators, charge hands, or followers, and for those duties only, and are not allowed to interfere with any of the electrical apparatus other than the trailing cable, gate-end switch, pommels, and starter handle.

There are cases where competent electricians are engaged on such machines owing to the dearth of employment and due to better wages being earned in such capacity than when engaged on the electrical staff. In such cases special permits are issued appointing such men as assistant electricians.

The coal cutting in my own case is all carried out on the night shift; one or more electricians are appointed in charge of the respective districts, depending on the number of machines at work and the extent of the district.

An electrical inspector is also appointed to visit the various districts at the different pits, the place and time being left to his own discretion. All such men report daily, such reports being countersigned by the electrician in charge of the particular pit and the night electrician in charge of all pits, such reports being afterwards inspected by the chief engineer or his assistant.

It is essential that qualified assistants be engaged who are capable of attending to breakdowns, unless of a very technical character, in which case the chiefs are called upon.

I shall be very pleased to supply your correspondent with copies of report forms and test sheets as used at these collieries, as space will not allow such to be printed in your "Correspondence" columns.

C. Jones, M.I.E.E., A.M.I.Mech.E.,
Mechanical and Electrical Engineer, Cannock Chase Collieries.

Chasetown, *December 31st*, 1923.

In your issue of December 21st, your correspondent, "M. E. B.," expresses anxiety as to the efficiency of those connected with the application of electricity to colliery work, in view of the recent report of H.M. Inspector of Mines upon accidents due to electricity in 1922. Your correspondent states that he has been at one time connected with colliery work, and he must therefore be conversant with the very arduous nature of the conditions under which electrical apparatus is called upon to work in coal mines—conditions more severe than those which obtain in any other industry, and but little understood by those outside the colliery world. It seems to me a striking advance in the scientific application of electricity that, in spite of the fact that the horse-power of electrical machinery installed in coal mines has risen from 317,000 in 1912 to 645,000 in 1921, the number of fatal accidents since 1912 has shown a steady decline.

Quoting from the address delivered in Glasgow in June, 1923, by Mr. W. T. Anderson, President of the Association of Mining Electrical Engineers, the three years' average of fatal accidents from shock has fallen from 10 for the years 1911-12-13, to two for the years 1920-21-22.

That this is largely due to an increase in stringency of the Government regulations for the use of electricity cannot be denied, but it is even more largely due to the increased technical knowledge, experience, and general efficiency of those engaged in the installation and maintenance of the plant.

Electrical machinery underground has perforce to be handled and controlled by men whose everyday work necessitates the continual exertion of considerable physical force; and the equipment has to be designed to withstand violent handling due, not to carelessness, but to the nature of the operator. It is only within the last ten years that equipment has been available which will stand up to such conditions, and industry generally owes a quite considerable debt to the colliery industry for demanding the production of what are arbitrarily known as "fool-proof devices." The unit type of oil-break switchgear, which is now becoming a standard for mills and other industrial works, has, to a great extent, been developed in the first place to meet the demands of the mining electrician.

The fatal accidents which still occur are generally due either to wilful derangement of apparatus or to the failure of the connection of portable apparatus with the general mass of earth. The latter fault is exercising the minds of colliery electrical engineers, and several types of apparatus have recently been developed with the object of preventing the operation of any portable apparatus unless the earth connection has first been adequately made.

G. M. Harvey.

Birmingham, *January 2nd*, 1924.

Single-phase Induction Motors and the Starting Problem.

The article by Mr. F. W. Davies is of very great interest; there is still a large field for single-phase work.

For very many years I have had under my control and maintenance, among others, a large number of single-phase motors, and the one outstanding thing I came up against (not mentioned by the author) was the human factor. Practically every squirrel-cage motor *starter*, sooner or later, was damaged or burnt out due to being left on the starting position too long, either through forgetfulness, or, more often, waiting for the motor to start when there were temporary mechanical reasons why it should not.

I fully agree with Mr. Davies regarding no-volt and overload releases; generally speaking, they are dreadful things and on "domestic" work should be avoided when possible.

No doubt it is difficult for the supply authorities to frame definite satisfactory rules regarding single-phase motors; the usual one, restricting the h.p. and relation of starting to full load current, leaves much to be desired.

It is quite easy to imagine a 10-h.p. squirrel-cage motor, in one street, causing less voltage fluctuation in starting, than a 2-h.p. in another street. With the more general use of electricity, this difficulty should automatically "flatten out" and disappear.

I join issue with the author regarding "Commutator" or "Repulsion" motors. In my humble opinion, if one has the maintenance of a large number of motors, there is no question that, notwithstanding the increased (1½ to twice) prime cost, in the end the "Com." motor is the cheapest. Moreover, there is no job which it cannot do, as well or better than, the squirrel-cage motor.

There are many points upon which I should like to touch in Mr. Davies's interesting and opportune article, but I fear I have already occupied too much space in your very interesting journal.

A. F. Harmer.

Wimbledon, *January 5th*, 1924.

Printing Telegraph Systems and Mechanisms.

Referring to the generous review of the above book in the colums of your issue for December 28th, there are one or two points raised by the reviewer to which I should like to have the opportunity of replying.

First of all, I would point out that I have dealt with the development of the art as it also exists on the Continent and in the United States, and have not treated it from the British standpoint alone. Consequently, in referring to the Hughes apparatus, I was thinking of its employment abroad, where large numbers are still in use and text-books on the maintenance and operation of Hughes's devices continue to be produced.

With regard to the Baudot correction, the epicyclic gear employed is a speed reduction gear, and when the star wheel is freed, the driving effort on the brush arms is zero. $MV^2/_2$ is of course in operation, but the friction of the brushes is a counteracting effect. That it is an extremely effective check is evident when it is considered that the time in which a correction can become operative is very small, and if there were a marked tendency for the brushes to be carried forward when unlocked, no correction would ensue.

If the speed is not exactly reduced to zero, it tends to become so very rapidly. What I wished to convey was that the brushes are not "stepped back," but tend to become stationary in space. Their position relative to the continuously moving shaft is, of course, backwards, but that is a very different thing to an actual physical movement.

With reference to the effect of "leakance" on speed, the quotation from Heaviside's work, with which I am familiar, does not disprove my statement. On a long line having capacity, distributed leakage, or even a lumped leak, will improve the shape of the signals, and thus better the reception, especially if the receiver is of the fixed-zero type such as a contact-making relay. It may even render reception possible where it would not otherwise be so. But it will set a limit to the attainable maximum speed, since this increases with the voltage applied to the receiver terminals. Since this voltage will be reduced as the leakage increases, my statement is correct.

In America, where land lines are much longer than those usual in this country, repeaters have frequently to be inserted on account of leakage losses. The Indian Telegraph Department specifies "wet" and "fine" weather speeds. If, as the reviewer suggests, the general belief prevails amongst telegraph engineers that leakance has no effect on speed, then the sooner they recast their ideas the better.

I quite agree with the reviewer that the adoption of the duplex balance has had a profound influence on the development of the multiplex system, and I do not propose to discuss

this at any length, but merely set out the historical facts so far as they relate to *achievement* and not mere *suggestion*.

The general method in use to-day by all designers and users of multiplex or high-speed automatic equipment employing rotary distributors involves the usual duplex balancing apparatus, together with sending and receiving rings. This plan was first put into force in 1896 by Pollock, of the British Post Office, and applied by him to the Delany multiplex system (see the first page of my preface).

Pollock's plant was, in 1900, used by Rowland on the quadruple-duplex printing system invented by him, and several installations were at work from that date onwards until the Rowland system went on the scrap heap. The reasons for its failure are well known, but the use of the duplex balance was not one of them (see pages 333, 393, 394, 403, and 404).

Pollock showed how to do it, and Rowland, in ignorance of Pollock's work, which was not published, showed that the Pollock method was applicable to equal letter multiplex systems, although this was perfectly obvious even with the knowledge of that time. The Pollock-Rowland method has since been followed by everybody, because, as a matter of fact, it is the only way. It has also been used by Mr. Booth to duplex the Post Office Baudot circuits, and credit is given to him for this in the preface.

Since all these facts are set out in my book, and as Messrs. Pollock and Booth are Post Office engineers, I do not agree that I can be charged with either neglecting or minimising the part played by the Post Office engineering staff in the development of the modern multiplex, but Rowland is entitled to some credit also, while your review has omitted all reference to Pollock.

In my opinion, another equally important factor contributing to the success of the modern multiplex is the keyboard perforator with automatic transmitter. The Rowland system had the duplex balance, and might have lived longer if it had been equipped with keyboard perforators, although its alphabet was against it. With a suitable printer, much higher outputs can be obtained when the transmission is automatic.

Twelve channels on one wire is spectacular, but is less efficient than eight when the speeds are 30 and 45 words per minute per channel respectively. Forty-five, 50, and even 60 words per minute per channel can be observed in any big American telegraph office employing the duplex-multiplex.

I have to thank your reviewer for the list of errors and also for the last paragraph of the review.

H. H. Harrison.

Liverpool, *December 31st*, 1923.

Electrical Apathy v. Gas Enterprise.

It seems that your correspondent who answered my letter and signs himself "Consumer" has entirely lost the point of my remarks. Please allow me space to put it even more plainly.

I said I required power in my flat, which is quite a reasonable request (the Gas Company having now fitted me out with a fine new fire with no "groans" about supply mains and no charges other than paying for the gas I burn, and a nominal hire charge per quarter for the fire, proves this).

The electricity supply company's terminals are in the basement with about 200 feet of conduit and cable to be run before they arrive at my hall door and meter (from which point I am quite prepared to run wiring at my own expense into the required positions in the flat), so I fail to understand what "Consumer" means by referring to the power company's not undertaking wiring on consumer's premises. His remark about a possible breakdown of the rising main is really amusing.

Take a parallel case in another trade, say a large department store which delivers its goods free in the London area by a dozen vans. Its goods become very much in demand and the vans become overloaded; does it write and tell its customers that the service cannot be rendered? No, it puts on more vans at its own expense and delivers to its customers without a murmur.

Now we have arrived at the secret (quite open and obvious); the power company has the monopoly, and you can either accept its terms, pay for what it tells you to, or go without.

According to the ELECTRICAL REVIEW share list the company about which I complained in my letter pays a dividend of 14 per cent. on ordinary shares. A little of this huge profit might well be used in the extension of mains and services.

I might mention that I am an electrical contractor.

R. Egerton Green.

London, *January 6th*, 1924.

Industrial Research.

The references by Mr. E. K. Scott to the Electrical Research Association in his otherwise excellent contribution in your issue of the 21st ultimo, are so wide of the mark as scarcely to merit serious attention.

It is not our experience that past presidents of the I.E.E., the leading technical experts of most of the large manufacturing concerns in the industry, and other able and active persons, when meeting in the day-time on committees of this association, are tired and worried. There would appear to be no better way of dealing with small matters and minor researches than that described. My dictum on this class of work should not be presented as though in contrast to the methods of the Mellon Institute making it appear to be a statement of the general policy of this association, which it obviously was not.

The Mellon Institute furnishes opportunities for individual researchers to do independent work. The Electrical Research Association provides means for co-operative effort, and for co-ordinating the work of independent workers wherever they may be. Thus an institute like the Mellon Institute would not replace and could not fill the position occupied by the E.R.A.

If Mr. Scott wishes to see such an institute founded in this country and thinks its methods adapted to the British temperament, he will do well not to decry the efforts of the very persons whose support will be indispensable.

His contribution, however, serves a useful purpose in so far as he emphasises once again the difference between the support given to research in this country and elsewhere. Scientific and technical men are fully alive to the importance of research. When will our men of means realise the opportunity of national service and service to humanity offered by the research movement and support it by liberal contributions to the associations and institutions fostering such work?

E. B. Wedmore,
Director and Secretary, British Electrical and Allied Industries Research Association.

London, *January 1st*, 1924.

Delayed Deliveries.

Interesting as the correspondence on the delivery question has been, your correspondent, Mr. Higgs, seems in his own mind to have overcome all, or at any rate, most, of the difficulties in connection with this troublesome problem. I believe your correspondent is known to me (and therefore I do not use a *nom de plume*), and that he specialises in standard material on the Ford car principle. By that I mean that he does not go in for anything special, and admittedly it is much easier for him to gauge the time required for material and labour, and probably, as he points out, he may have finished articles in stock, and is therefore able to make delivery within a reasonable time of the promise given.

How different is the case of the manufacturer who makes some thousands of different articles, a large number of which can, and have to, be designed in accordance with the customer's special "kink" (if you like to call it such), and taking into consideration the use the article will be put to from a utility, decorative, &c., point of view, will your correspondent kindly say:—

(1) How it is possible in such cases to order in advance.

(2) How to estimate time lost in unforeseen difficulties in manufacture in giving a promise of delivery.

(3) How to escape the well-known outside supplier's phrase "in stock subject to being unsold," and finding two days later that it takes five or six weeks to deliver.

(4) How to escape constant promises of delivery which do not materialise for raw material.

In conclusion, I should like to point out this experience: An order placed by a steel company was very urgently called for and cancellation was threatened if delivery was not made within the next few days, whereas the manufacturers of the particular goods were actually waiting for the steel company to deliver the sheet steel, which was then three months overdue in accordance with their promise of delivery.

A. S. Goodman.

Birmingham, *January 1st*, 1924.

The Future of Radio-Broadcasting.

Under the above heading, in yesterday's issue of the ELECTRICAL REVIEW, Mr. A. E. Chapman says that "all licensing difficulties which have been experienced in the past have been smoothed over, and licences are now issuable upon a simple and fair basis satisfactory to the public, the B.B.C., the State, and the trade."

If one substituted the word "ludicrous" for "fair" in the above sentence I think we should be nearer the truth, and when one comes to think of it one realises that the present basis is far from satisfactory to a certain section, and I venture to suggest an important section, of the public, namely, the amateur experimenter. At present there are three types of licences available, viz.:—

(*a*) The B.B.C. licence, costing 10s.

(*b*) The constructor's licence, costing 15s. And

(*c*) The experimenter's licence, costing 10s.; or, if it is desired to listen to the B.B.C. programmes, 15s. This means, of course, that *every* new experimenter's licence issued costs 15s., for it is fairly certain that no experimenter could conscientiously say that he would never listen to the broadcast programmes.

The constructor's licence enables one to buy and make whatever apparatus one likes, provided that one does not "know-

ingly " buy foreign-made stuff. (That " knowingly " is good!) and the licensee is allowed to conduct experiments if he wishes to. What then, is the difference between the constructor's licence and the experimenter's licence? Merely that the experimenter may buy cheap, shoddy foreign-made stuff if he wants to! No sincere experimenter would ever buy this imported rubbish, and therefore the distinction between the two 15s. licences is a snare and a delusion.

The rub, however, is in the way these licences are issued. The experimenters' licences are bound up with miles of red tape, and they are consequently very difficult to get. The constructor's licence, on the other hand, can be got for the asking at the local Post Office; the consequence is that large numbers of those who, in the ordinary way, would apply for, and deserve, experimenters' licences, prefer to take the easier path and be content with constructors' licences. The inevitable result is that the number of experimenters' licence holders is getting proportionately less and less, and their voice will become as that of one crying in the wilderness, unheard because of the clamour of the countless listeners-in for more and more broadcasting. I am saying nothing against the B.B.C., for which I have the greatest regard, but I do feel that the present licensing position is very much against the interests of the genuine experimenter. Surely the trans-Atlantic successes of the past few weeks have proved that the experimenter is worthy of certain privileges. He is, therefore, worthy of more recognition. His only hope lies in the various radio societies and in the technical Press. That is why I have bothered you with this lengthy epistle.

J. F. Stanley, B.Sc., A.C.G.I., F.R.A.

London, *January 5th*, 1924.

The Quantum Theory.

I have pleasure in trying to answer your questions, for, by helping each other, we may possibly begin to understand *what* we are talking about—leaving how and why alone.

By *sensation* I mean the state or condition of my cerebral cortex, at any particular moment, due to an effect on my nerve-endings. All my experience is the result of such reactions to stimuli.

A body when in motion can shift and lift other bodies, and so do *work*. " Energy " means this ability to do work, which is measured in foot-pounds; but, when time has to be taken into account, " power " comes in as the *rate* of doing work. Are we agreed?

Since writing you on the 23rd ult. I have had an opportunity of perusing nearly 90 large 4to pages of letterpress issued by the Physical Society of London in the form of a " Report on Radiation and the Quantum Theory," by J. H. Jeans, the author of which has studied these matters closely for more than nine years, and most readers will admit that " to expand the report into a complete treatise nothing less than ten times the space available would have sufficed "; but enough has been published to enable one final conclusion to be drawn. " We find—or at least we think we find—that nature consists of a series of more or less abrupt jumps. . . . so minute and so close together as to produce the illusion of continuous motion "—shall we say just like films at a kinema?

However, let us start at the beginning: " The quantum theory . . . had its origin in an attempt to account for the spectrum of black-body radiation," so I fear that the photographing of a hot kettle in the dark, by a friend of mine many years ago, really was a case of Satan finding " some mischief still for idle hands to do "!

A crucial test of the Newtonian Mechanics is " the phenomenon that (author's own italics) *the total radiant energy per unit volume in temperature-equilibrium with matter is finite, and not infinite*. To understand the meaning of this phenomenon, and at the same time to make the question as definite, and as simple as possible, let us fix our attention on an enclosure with perfectly reflecting walls in which there is a mass of iron at 0 deg. C., and let us suppose that there is a state of equilibrium inside the enclosure. The iron is continuously radiating energy from its surface into the space inside the enclosure, and is also absorbing energy from this space."

Well, Sir, first we are asked to fix our attention on a non-existent, and then we are to suppose an impossibility, viz.: that, when there is temperature-equilibrium between the enclosure contents, there can be no radiation from and to and between any two—or absorption by either. It is, surely, a contradiction in terms! Yet upon this illogical assertion more and more evidence is piled till " It seems then to be abundantly proved that the transfer of energy must in some way take place by jumps and jerks of amount $E = hr$; but "mathematical analysis gives no indication as to the physical nature of these processes. The physical problem as to when, where and how the jumps occur can be solved with much less certainty than the mathematical problem of which the solution has predicted the occurrence of energy jumps with a high degree of certainty."

If energy has jumps and jerks it is assumed to be a material entity; and I venture again to urge upon all the great desirability of correctly and more precisely defining our terms before attempting to think clearly. To me these jumping-quanta-bundles are about as real as Lodge-spooks or Doyle-ectoplasm—and just as useful. Mark Twain's Wizard could tell what the Emperor of China was having for dinner, but not what a poor man had had for breakfast, and I wonder if any superior person can tell me if a body, when no longer supported, falls to the ground by imperceptible jumps and jerks, or why it falls at all?

Facts Before Fancies.

January 5th, 1924.

Motor Starter Regulations.

" Breakdown " has raised an issue in your journal which is of concern to the manufacturer of motor starters. So long as there is a demand for small motor starters, the maker will meet it, but he must think of the possibility of a change in practice. It does not appear to be reasonable to employ a starting contrivance for a 2-h.p. squirrel-cage motor when a 2- or 3-kW cooker or radiator may be switched direct on to the line.

When the lighting load was the main consideration of the supply authorities, and generating plants and cableways were on a small scale, there existed a necessity for devices to prevent flicker as the occasional motor started up. The conditions are much different now; the small motor bears the same relation to the cable network as a lamp did in the early days of electricity supply. " Breakdown " is not so much the victim of red tape as of tradition. It is time the regulations were overhauled.

The risk of blowing the service fuses may have been a reason for insisting on the use of a starter for a motor. That would mean delay in getting the machinery to work until the mains engineer had been called in to replace the fuse wire. Fuses are as troublesome on the one side as regulations are on the other. This risk can be obviated to-day, for thoroughly reliable circuit-breakers are available; breakers which the consumer can be left to operate with safety, and on which the time element can be adjusted with an accuracy impossible with fuses. These breakers can be used as " direct on " starters for single motors, thus simplifying the apparatus required with a motor.

Anything which tends to simplify control apparatus and cheapen the cost of installation should be considered by engineers whose business is to further the electrification of industry. It would be interesting and useful to have the opinions of both supply and works engineers on this subject.

The question of starters for squirrel-cage motors is also worth the attention of engineers in charge of large works plants supplied with high-pressure power or with their own power generators. If a 150-kVA transformer may be switched on to the line without a " charging " device, there would appear to be little reason for using a starter to connect even a 10- or 15-h.p. motor to the transformer secondary. Is the " star-delta " starter to become obsolete?

For **George Ellison,**

WM. F. N. HARPER.

Birmingham, *January 7th*, 1924.

Would not " Breakdown " have spared himself the discomfort of being entangled in " municipal red tape " and saved himself, his customer, and the Corporation official time and trouble, if he had taken the precaution to make himself acquainted with the wiring regulations of the supply authority concerned *before* undertaking the installation of the motor?

It is interesting also to note that the fact of one particular firm not listing a starter under 3 h.p. " proves " the line of demarcation between starters and no starters.

Foresight.

January 7th, 1924.

Letters have been received, too late for insertion in this issue, from Messrs. A. C. Scott & Co., Ltd., Mr. Sydney Evershed, " Wanderer," " Pelican," " Motor Sales Engineer," Mr. H. B. Lee, and Mr. D. B. Hoseason.

The " Model Engineer " Exhibition.—On Friday last the exhibition of " small power engineering " and scientific apparatus organised by the *Model Engineer* was opened at the Royal Horticultural Hall, Westminster; it remains open until this (Friday) evening. The Hall, as usual, is crowded with stands showing all kinds of supplies for model-makers, as well as actual model locomotives, yachts, hydroplanes, aeroplanes, and complete railways capable of carrying adult passengers; a very high degree of skill is manifest in many of the examples of amateur workmanship, reflecting great credit on the industry and patience of the makers. A notable feature of the show is the variety of ready-made small parts and accessories which can now be obtained from manufacturers. Radio apparatus is, of course, well represented, but not out of proportion to the rest. On the occasion of our visit there was a large attendance, and a good deal of business was being done.

Business Notes.

Bankruptcy Proceedings.—STANLEY SIDWELL, 51, Islington Row, Birmingham, electrical engineer.—The first meeting of the creditors was held on December 31st at the Official Receiver's Office, 191, Corporation Street, Birmingham. According to the statement of affairs, there was a deficiency of £307. Debtor attributed his failure to commencing business with insufficient capital, bad trade caused through the general depression in trade, and the depreciation of wireless materials. It appeared that in March, 1922, he commenced business on his own account at his present address with £60 capital, part of which represented his army gratuity. He stated that his capital was insufficient for the class of business in which he was engaged, and in June, 1922, he borrowed £60 on the security of a life policy for £125, and in the following October a further £40 was borrowed. From the commencement he had traded under difficulties, and the business had never provided a living. The matter was left with the Official Receiver as trustee of the estate.

JACK SHAPERO, electrician, who also carried on business as a tailor at 527, Kingsland Road, Dalston, under the style of Sharpe Bros.—The first meeting of creditors was held on Monday, at the London Bankruptcy Court, under a receiving order. Mr. D. Williams, Official Receiver, reported that the debtor had stated that he commenced business six years ago with a capital of about £40 or £50 and he ran the tailor's business under the management of his father. Some eight months ago there was a burglary, goods to the value of £350 being stolen from that branch. The debtor was insured against burglary but his claim was opposed by the insurance company on the ground that he (debtor) had registered his brother as the owner of that business. Asked why he took that step, the debtor stated that in January, 1923, an action was launched against him by the British Thomson-Houston Co., Ltd., for infringement of an electric lamp patent. He thereupon thought it necessary to keep the two businesses separate and registered his brother as the owner of the tailoring branch. The British Thomson-Houston Co. obtained judgment against him for about £300 and the insurance company refused to pay him any compensation for the burglary, alleging that he was not the owner of the business. The Chairman further reported that the debtor executed a deed of assignment in August last and the insurance claim was handed over to the trustee thereunder. The debtor returned liabilities of £722, apart from the claim of the British Thomson-Houston Co., which would have to be added, and assets valued at £85. The failure was attributed to the loss by burglary, depreciation in the value of stock, and bad trade. Mr. Robinson attended for the debtor, who made no offer, and the case was left with the Official Receiver to be wound up in bankruptcy.

A. H. MILNES, electrical engineer, 48, Lidget Street, Lindley, Huddersfield.—Receiving order made December 29th on debtor's own petition. First meeting and public examination January 14th, at the Court House, Huddersfield.

G. H. B. SNELL (House & Snell), electrical engineer, 6-8, Duke Street, Margate.—Discharge suspended for four years. (Date of discharge, September 14th, 1927.)

A. VIVIAN, electrical engineer, 180, Gray's Inn Road, W.C. —Last day for proofs for dividend, January 18th. Trustee, Mr. D. Williams, Official Receiver, Carey Street, W.C.2.

Company Liquidations.—CAR IGNITION & LIGHTING CO., LTD., electrical engineers, late Page Street, Westminster, London, S.W.—A meeting of the creditors was held recently at 29, Martin Lane, Cannon Street, E.C. Mr. J. T. Cave, the liquidator in the voluntary liquidation, reported that he had also been appointed as the receiver for the debenture holders. According to the statement of affairs presented, the amount due on the debentures was £732, and the assets were insufficient to fully discharge that amount. The deficiency as regarded the debenture holders was £286, and there was no balance available for the unsecured creditors. The claims of the trade creditors totalled £498, while £187 was owing for rent, &c., and £45 in respect of salaries. The assets consisted of: Cash in hand, £40; plant, machinery, stock and furniture, £410, expected to produce £65; and book debts £485, valued at £385; making total assets of £489, from which had to be deducted £44 for preferential claims. Mr. Cave stated that the company was registered on November 4th, 1921, to acquire as a going concern a business which had previously been carried on at Page Street, Westminster, under the style of the Car Ignition & Lighting Co. The capital was £1,500, all of which had been issued and was fully paid up. Shares to the value of £600 were issued to the vendors in payment for the assets required, of which £550 was for the goodwill. Shares to the value of £900 were issued for cash. Debentures for £700 were created and issued in January, 1923, also for cash. No interest had ever been paid on the debentures. The company started at 26, Page Street, but later acquired No. 28 in the same thoroughfare at a rental of £250 per annum. That additional commitment seriously impeded the progress of the company. The turnover was approximately £4,000 to £6,000 per annum, and did not warrant the maintenance of such large premises. During the period ended October 31st, 1922, there was a loss on the trading of £710, whilst in the following twelve months there was a further loss of £709. The total loss during the two years' trading was £1,419. The expenses of the business were then curtailed, and a portion of the premises was sublet. Since October, the position of the company had improved, but on December 5th last a receiver had to be appointed to protect the assets. As the receiver he carried on the business for one week, and after going fully into the position he came to the conclusion that the company should be liquidated at once. Creditors had been pressing, but proceedings were stopped by the appointment of the receiver. He added that as the assets could not fully discharge the amount due on the debentures, the unsecured creditors could not expect any dividend. No resolutions were passed, and therefore the voluntary liquidation of the company will be continued, with Mr. Cave as liquidator. The following are creditors:—

	£		£
Burke, S. W., & Co.	23	Smith, H. W., Ltd.	68
British Lighting & Ignition Co.	12	Société des Accumulateurs Elec-	
Morgan Crucible Co.	20	triques	37
North-East Service	110	Vandervell, C. A., & Co.	45
Peel-Conner Telephone Works...	21	Westminster Electric Supply	
Ripaults, Ltd.	19	Corporation	20
Robinson & Co.	16	Millbank Estate Co.	246

A. G. WRIGHT & Co., LTD., wireless manufacturers, &c., 302a, Kentish Town Road, London, N.W.—In pursuance of the provisions of the Companies (Consolidation) Act, a meeting of the creditors was held on January 2nd, at the company's offices, when Mr. F. G. Pullinger, of 47, New Cavendish Street, London, W., the liquidator, stated that at a meeting of the shareholders, held on December 17th, the shareholders passed a resolution to wind up voluntarily, and had appointed him liquidator. The unsecured liabilities amounted to approximately £1,622, while there were preferential claims for £190. The paid-up capital amounted to £2,950. The assets totalled £2,566. The company was formed in 1903 with a capital of £400, and in February, 1923, the company saw a possible future for manufacturing wireless parts and it was decided to increase the capital by the issue of 3,600 preference shares of £1 each. The company were previously engineers. New machinery and plant was installed when the boom started, but by the time they commenced to manufacture wireless apparatus the slump had set in. The company was unable to obtain further capital and there was no alternative but to go into voluntary liquidation. After some discussion it was decided to confirm the voluntary liquidation, with the present liquidator, and a committee consisting of Mr. Fox (of Messrs. E. F. Moy & Co.), and Mr. Harrison, of Kentish Town.

WHITE, ANDREWS & Co., LTD.—A meeting of creditors was called for January 7th. Particulars of claims to the liquidator, Mr. M. F. Hunter, 15, Water Lane, E.C., by January 27th.

BRITISH RADIO-WIRELESS MANUFACTURING CO., LTD.—A meeting of members is called for February 8th at 14, St. Mary Axe, E.C., to hear an account of the winding-up from the liquidator, Mr. C. W. Burgess.

HOLBORN RADIO CO., LTD.—A petition for the winding-up of this company has been presented to the High Court by the Sterling Telephone and Electric Co., Ltd., of 210-212, Tottenham Court Road, W.C., and will be heard in London on January 15th.

SHERINGHAM DAYLIGHT (FOREIGN)) LTD.—A meeting of creditors is called for January 21st at 296, Regent Street, W. Liquidator, Mr. C. Millar.

ELECTRADS, LTD.—A meeting of members is called for February 11th at 133, Moorgate, E.C., to hear an account of the winding-up from the liquidator, Mr. G. F. Baguley.

Dissolutions of Partnership.—WATSON & STRATTON, electrical contractors, 7, Chimes Avenue, Palmers Green, and at 1, Grove Road, New Southgate.—Mr. G. Watson and Mr. C. Stratton have dissolved partnership. Mr. G. Watson will attend to debts.

PROVAND & CAIRNS, electrical engineers, 8, Blythswood Square, Glasgow.—Mr. N. Provand and Mr. A. McF. Cairns have dissolved partnership. Mr. J. Thomson, Jun., the late manager, will attend to debts and continue the business on his own behalf.

WILLIAMS, PELL & BARING, electrical and mechanical engineers, mercantile agents and merchants, 281, Gray's Inn Road, W.C.—Messrs. A. Williams, F. B. Pell, and J. T. Baring have dissolved partnership. Debts will be attended to by Messrs. Williams & Pell, who will continue the business under the same style.

Trade Announcements.—A wholesale and retail wireless depôt has been opened by MR. L. A. STURROCK, of 29, John Finnie Street, Kilmarnock.

Among new Scottish companies registered is J. B. MEIKLEJOHN, LTD., 115, Bath Street, Glasgow. Capital £10,000 in £1 shares. Private company to carry on the business of electricians, electrical engineers, &c.

THE "M.K." ELECTRIC, LTD., have built a larger factory to meet the increased demand, and they have now removed into it at Wakefield Street, Edmonton, N.18.

MESSRS. W. T. GLOVER & CO., LTD., of Trafford Park, inform us that they have appointed Messrs. J. H. Collie & Co., Ltd., 8, Harrington Street, Liverpool, as their representatives in the Liverpool district. Tel. No. 5039 Central. A stock of rubber-insulated wires, cables and flexible cords will be maintained there.

THE PARK ROYAL ENGINEERING WORKS, LTD., have issued to their customers a letter regarding statements that have gained currency to the effect that they are no longer in a position to execute orders for switchgear and their products generally. They state that while a receiver has been appointed pending the reconstruction of the company's finances, they are in a position to supply high- and low-pressure switchgear, measuring instruments and all their usual lines with promptitude and of their usual design and workmanship. They have recently secured several important contracts from central stations, Government departments, &c., and have orders for the main d.c. board at the power house at the British Empire Exhibition, Wembley.

MESSRS. RADIO INSTRUMENTS, LTD., of London, have appointed Messrs. J. Corstan Sinclair & Co., 47, Waterloo Street, Glasgow, as their representatives for Glasgow and Edinburgh, including the Southern Counties of Scotland. The Electrona Supply Co., of 164, Market Street, Aberdeen, have been appointed representatives for Aberdeen and certain Northern Counties of Scotland for the same company.

TWISS ELECTRIC TRANSMISSION, LTD., 3, Victoria Street, London, S.W.1, have opened branch offices at 24, Pearl Buildings, Newcastle-on-Tyne, under the management of Mr. G. P. Howkins, A.M.I.E.E., M.M.Min.E., who will attend to all their increased business in the area comprising Northumberland, Cumberland, Durham, Westmorland, and the Northern part of Lancashire and Yorkshire.

MESSRS. W. H. WILLCOX & CO., LTD., have registered the following code addresses: Telegrams: "Enginsplys, Boroh, London"; cables: "Enginsplys, London."

MESSRS. PHILLIPS & SONS (CHISWICK), LTD., electrical engineers, have removed from High Road, Chiswick, W.4, to 42, Waterford Road, Walham Green, S.W.6.

Mr. R. J. PAUL, late London manager of Messrs. E. Brook, Ltd., has joined the sales staff of Messrs. Bates & Windibank, of London, London and South of England distributors for Messrs. F. & A. Parkinson, Ltd., Guiseley, and Messrs. Flather & Co., Ltd., Leeds, manufacturers of a.c. and d.c. electric motors.

Catalogues and Lists.—THE CABLE ACCESSORIES CO., LTD., Britannia Works, Tipton, Staffs.—A well-produced catalogue (148 p.) containing illustrated details and prices of electric lighting fittings, including watertight lanterns, reflectors of all types, hand lamps, fuses, brackets, and standards. Also illustrated pamphlets dealing with switch- and fuse-gear, "Revo" electric fires, and other domestic appliances.

THE FOSTER ENGINEERING CO., LTD., Morden Works, Wimbledon, S.W.19.—A number of illustrated pamphlets, &c., advertising the firm's transformers, gasfilled lamp fittings, "Apex" switchgear, and other products. A pamphlet illustrating examples of the firm's transformers, issued on the occasion of the production of the 50,000th transformer.

MESSRS. SIEMENS & ENGLISH ELECTRIC LAMP CO., LTD., 38-39, Upper Thames Street, E.C.4.—January price list of electrical supplies. List prices are given with key letters indicating discounts.

MESSRS. WARD & GOLDSTONE, LTD., Frederick Road, Pendleton, Manchester.—Radio List No. 104, containing illustrations and prices of radio-telephone receiving sets, parts, and accessories.

MESSRS. SPENCERS (ELECTRICAL), LTD., 7-9, White Cross Place, Wilson Street, E.C.2.—A price list of "Conqueror" lamps, including automobile patterns.

THE "ATTRACTA" RADIO CO., 11, Hanway Place, Oxford Street, W.1.—An illustrated and priced leaflet giving particulars of the "Ariel" radio receiving set.

THE STERLING TELEPHONE & ELECTRIC CO., LTD., 210-212, Tottenham Court Road, W.1.—Publication No. 388, showing applications of "Sterling" radio receiving sets. Also Publication No. 391, dealing with lightweight head telephones with "Duralumin" headbands. The company has also issued a cardboard cut-out advertising its "Sterling Baby" loud speaker.

MESSRS. H. C. TOFIELD, LTD., 30, Church Street, Birmingham.—An illustrated and priced catalogue containing details of "Syren" radio-telephone receiving sets.

MR. GEORGE P. COSWAY, The Arcade, Nuneaton.—A pamphlet containing a detailed and illustrated description of the "Dred-Nort" link disconnecting box.

Messrs. CROMPTON & CO., LTD., Chelmsford, Essex.—A well-illustrated description of the Crompton-Robertson combination slide-wire bridge and potentiometer.

Messrs. FERGUSON PAILIN, LTD., Higher Openshaw, Manchester.—A brochure dealing with the remarkable progress made by the firm since its inauguration in 1913, copiously illustrated with views of the company's works and products.

THE MULLARD RADIO VALVE CO., 45, Nightingale Lane, Balham, S.W.12.—Leaflet V.R. 6, dealing with the "Mullard dull emitter valve, and a leaflet and poster giving the reduced prices of "O.R.A.," "A.," and "B." valves.

MESSRS. BULL MOTORS, LTD., Stowmarket.—List No. 11-23, containing illustrations, dimensioned drawings, and specifications of "Bull" d.c. dynamos, motors, and motor-generator sets. Also pocket price lists of these machines and switchboards.

Book Notices.—"Cambridge Galvanometers" is the title of a brochure about to be issued by the Cambridge and Paul Instrument Co., Ltd. (List No. 167); it is one of those trade publications which are of permanent value, because they contain technical information relating to the subject with which they deal. In the present instance the first section is devoted to "General Principles," and briefly explains the leading characteristics of galvanometers and their bearing upon the various purposes for which the instruments are used. Methods of magnification of deflections and the factors which control sensitivity are discussed, and the sensitivity data of the various types of galvanometer are fully tabulated; the most sensitive instrument in the list gives 1 mm. deflection at one metre distance, with a current of 0.000083 micro-ampere.

The remainder of the brochure contains illustrated particulars of the numerous types of galvanometer that are made by the company, embracing representatives of almost all known varieties, and including apparatus recording both by ink and by photographic methods, with numerous reproductions of typical records. A concluding section gives details of the accessories employed in galvanometry, including a variety of suspensions. The brochure, which is not a price list, will be found most useful as a source of information, and it also contains many references to the literature of the subject.

"*The Electrical Engineer's Year Book and Diary*, 1924." (Pp. 484.) London: S. Davis & Co. Price 21s. post free.—The absence of the preface to draw attention to alterations and additions, which is a usual feature of annual publications, makes it difficult to trace what has been added or amended in this, the sixteenth, edition. It is a few pages shorter than the last edition, but the only item which appears to have been dropped is the table showing the system and degree of illumination required in various industries. The new matter includes a short article on chemical rectifiers.

"The *Journal* of the Junior Institution of Engineers," January, 1924. London: Percival Marshall & Co. Price 2s.—Three papers are reproduced in this issue:—"Technical Arbitrations," by W. A. Tookey, M.I.Mech.E.; "Modern Locomotive Lubrication Practice," by B. Spencer; and "Amateur Cinematography," by Dr. C. E. K. Mees. There are also reports of meetings and visits, reviews, &c.

"The Decimal Educator," December, 1923. London: The Decimal Association. Price 6d.—In this issue appears a report of the annual meeting of the Association, and an address by Sir Richard Gregory, D.Sc., the president, on "The Metric System and Internationalism." The president reiterated the need for a simplification of the systems of measurement at present in use in this and some other countries, showing how trade was handicapped by the confusion arising out of the lack of uniformity. Mr. Harry Allcock contributes an article upon the decimalisation of British currency, and many other interesting notes and articles on various phases of the decimal system are published.

"The Electronic Theory of Valency"—a general discussion held by the Faraday Society. London: The Society. Price 10s. 6d. net.

"Concrete Year Book, 1924." Edited by O. Faber and H. L. Childe. Pp. 352. London: Concrete Publications, Ltd. Price 2s. 6d. net.

Calendars and Diaries.—MESSRS. CRYSELCO, LTD., Bedford, have sent us a desk calendar with monthly slips and a memorandum pad.

MESSRS. CROGGON & CO., LTD., Upper Thames Street, E.C., have distributed a wall calendar with monthly sheets bearing illustrations of electric fires, bells, irons, &c.

A New Year souvenir has been issued by MESSRS. F. & A. PARKINSON, LTD., of Guiseley, Leeds, on the occasion of its annual social. It takes the form of a folder entitled "Alternations," containing some interesting writing with regard to the business and works of the company, the enterprising spirit which possesses it, and a new co-partnership scheme by which any employé may become a shareholder, his shares being subscribed for by weekly payments and a dividend of 5½ per cent. per annum, free of income tax, being paid.

MESSRS. CROMPTON & CO.'s (Chelmsford) calendar has large monthly sheets bearing illustrations of the firm's plant.

From the Industrial League and Council (82, Victoria Street, S.W.1) we have received a useful pocket diary for 1924. It contains a good deal of industrial and commercial information, including a list of Joint Industrial Councils, Trade Boards, tables of strikes and lock-outs (1900-23), a directory of societies, and particulars concerning trade unions and the League and Council itself. There is plenty of space for daily engagements and memoranda, and copies may be obtained from the offices (2s. 6d.).

A cardboard cut-out representing an electric vehicle with weekly date slips, has been received from MESSRS. WALKER VEHICLES, LTD., Caxton House, Westminster.

MESSRS. W. H. WILLCOX & CO., LTD., Southwark Street, S.E., have sent us a calendar with monthly sheets bearing illustrations and materials and appliances supplied by the firm.

A vest pocket calendar has been received from the University Engineering College, of Westgate-on-Sea, Kent, also a New Year pencil souvenir.

Monthly cards for a calendar sent us on a previous occasion have been received from MESSRS. FULLER'S UNITED ELECTRIC WORKS, LTD., Chadwell Heath, E.

A handy calendar with monthly sheets having spaces for memoranda has been received from MESSRS. W. H. SUGDEN AND CO., LTD., Glenny Road, Barking.

Utility is the keynote of a wall calendar received from the DAVENPORT ENGINEERING CO., LTD., Bradford, which has a block of daily slips with bold figures.

THE SHROPSHIRE, WORCESTERSHIRE & STAFFORDSHIRE ELECTRIC POWER COMPANY, of Smethwick, has chosen as the subject for a large and handsome calendar for this very uncertain year, "Dawn" (E. Moeller), a charming view across the sea at the first breaking of the new day after a stormy night. It is a picture representative of the vast powers of Nature which still lie beyond the control of man.

MESSRS. SUTCLIFFE BROS. & BRYCE, LTD., of Hyde, have issued a serviceable pocket diary, &c., containing calendars for 1924 and 1925, ample daily space, and a number of useful tables, including football and cricket information.

THE PIRELLI-GENERAL CABLE WORKS, LTD., of 144, Queen Victoria Street, London, E.C., has issued a calendar for 1924, consisting of vest-pocket celluloid covers containing a few memoranda sheets.

THE KEY ENGINEERING CO., LTD., of 4, Queen Victoria Street, London, E.C.4, has prepared a vest-pocket calendar card in celluloid.

The "Sterling" Demonstration Car.—A very practical way of advertising its radio-telephone apparatus is being employed by the STERLING TELEPHONE AND ELECTRIC CO., LTD. This is the use of a car fitted with receiving sets, amplifiers, loud speakers, and components arranged ready for demonstrating at a moment's notice. A four-wire aerial is stretched between posts at the back of the car and a "jib" fitted at the front. The car is illustrated in the accompanying picture.

"STERLING" DEMONSTRATION CAR.

For Sale.—Messrs. H. Butcher & Co. will sell by auction, on January 17th and 18th, at 13, High Holborn, W.C., a large quantity of electrical and wireless accessories, material, stores, cable, &c. (See our advertisement pages to-day.)

New Belgian Companies.—There has been formed at Velm the Centrale Electrique de Velm for the generation or purchase of electric current and its distribution in the township of Velm and neighbourhood. Its capital is unlimited, with a minimum of 26,000 fr.

The Nouveaux Etablissements Eugène Hurstel is a company formed to replace a company of the same name. Its capital is 600,000 fr. and its operations embrace the manufacture of measuring instruments, machine tools, &c. Its offices are at 34, Rue de Laeken, Brussels.

Oppagne-Wenin-Electricité is the style of a co-operative company formed at Oppagne to supply current to that town and neighbouring townships. The capital is unlimited, but fixed at a minimum of 20,000 fr.

With a capital of 600,000 fr. there has been launched at Drogenbosch-lez-Bruxelles (Rue Longue) La Plastrisola, a company for the manufacture of plastic and insulating substances.

There has been embodied at Brussels (158, Rue Royale) a company styled Tramways et Electricité en Russie for the carrying on of electrical undertakings of all kinds, and principally in Russia. Its capital is 13,000,000 fr.

British Financial Mission to Brazil.—*Reuter* reports the arrival at Rio de Janeiro at the end of December of the members of the British financial mission, who have visited Brazil at the request of the Brazilian Government with regard to questions connected with the investment of British capital in Brazil.

Electricity Supply Rifle League.—The following are the results of matches during the winter session:—Central A, 582, Central B, 558; Central A, 583, City, 579; Central A, 579, County, 578; Central A, 583, Hackney, 525; Central A, 584, Metropolitan, 579; Central A, 583, St. James, 566; Central A, 588, West Ham, 515; City, 584, Central B, 558; County, 571, Central B, 552; Central B, 556, Hackney, 523; Central B, 561, Metropolitan, 561; St. James, 553, Central B, 548; Central B, 546, West Ham, 510; City, 585, County, 577; City, 584, Hackney, 490; Metropolitan, 574, City 571; City, 571, St. James, 550; City, 585, West Ham, 541; County, 580, Hackney, 522; County, 585, Metropolitan, 569; County, 583, St. James, 529; County, 570, West Ham, 536; Metropolitan, 566, Hackney, 516; St. James, 547, Hackney, 503; Hackney, 528, West Ham, 495; Metropolitan, 579, St. James, 544; Metropolitan, 580, West Ham, 511; St. James, 557, West Ham, 494. The County Co. heads the league with 26 points; the Central A team is second with 24 points; and the City Co. is third with 22 points.

Annual Dinner.—The annual dinner of the indoor and outdoor staffs of Messrs. Francis Polden & Co., Ltd., was held on Saturday last at Slater's Restaurant, Cannon Street. In the toast of the "Social Committee," proposed by Mr. A. C. Hill, the committee was heartily congratulated. Mrs. Polden was presented with a bouquet and Mr. Polden with a chairman's hammer and striking block as a mark of esteem. Mr. R. T. Shaw gave the toast of "The Chairman and his Company," and Mr. Polden responded in a few appreciative words. Mr. P. Wood proposed the toast of "The Ladies and Visitors," and Mr. W. T. Smith responded. Mr. Polden, in submitting the toast of "The Indoor and Outdoor Staffs," said how much he valued the ready and willing co-operation of both, and Mr. W. T. Buswell responded on behalf of the Indoor Staff and Mr. H. G. Simmonds for the Outdoor Staff. A very fine musical programme was rendered by the "Gay Sextette" concert party after the dinner.

New Zealand's Trade with Germany.—Since the war, until September 1st last, no German goods were allowed to be imported into New Zealand except under special licence from the Minister of Customs. During the last complete year (1922) the value of goods so imported amounted to £23,537, generators, motors and transformers accounting for £275 of this total. In the same year goods to the value of £218,338 were exported to Germany.

Electrical Trade of Australia.—In the course of his report for the year ending June, 1923, which is abstracted in last week's *Board of Trade Journal*, Mr. S. W. B. McGregor, H.M. Senior Trade Commissioner in the Australian Commonwealth, says that Australia offers an increasing market for electrical machinery, which would appear, in certain cases, to justify British manufacturers in strengthening their Australian organisation. Owing to the revised classification, the value of imports of electrical machinery in 1922-23 cannot be compared with that in 1921-22. In the latter year the imports were valued at £1,349,210, and countries of origin were:—

	£
United Kingdom	688,997
Sweden	33,016
United States	606,350
All countries	1,349,210

In 1922-23 values of imports of electrical machinery and appliances, &c., were:—

	£
Dynamo electrical machines	944,319
Fans, electric	38,103
Fittings, electric	219,211
Heating and cooking appliances	21,194
Lamps, filament, for lighting or heating	338,431
Measuring and recording instruments	175,903
Regulating, starting and controlling appliances	528,024
Static transformers	146,085
Tel. instruments and appliances	4,735
Telephones	195,912
Electrical appliances, n.e.i.	478,572

Insulated Wire and Cable.—Imports in 1922-23 were valued at £1,205,706, and in 1921-22 were:—

	£
United Kingdom	860,000
Japan	3,930
United States	22,237
All countries	888,184

With regard to foreign competition, for the nine months ended March, 1923, the imports from the United Kingdom aggregated £52,731,797, and those from U.S.A. £17,661,708. It is stated that the competition of the United States continues to be in metals, metal manufactures, machinery and motor-cars. "As regards steel plates, sheets, and sections, an extensive inquiry made during the year revealed the fact that, speaking generally, United States steel is more uniform in quality and finish than British, also United States firms pay greater attention to packing steel material than British firms. Japanese competition is principally in silk. German competition is at present inappreciable. A few tools, motor-cars, and pianos are coming in."

Employment in Switzerland.—The economic situation in Switzerland in the course of the latter months of last year, it is said, showed a considerable improvement. The activity in the building trade and better employment in the machine industry (occasioned by the progress made with the electrification of the Federal railways) have brought to an end the unemployment which marked the beginning of the year.

The F.B.I.—The annual meeting of the Federation of British Industries is to be held at the Hotel Cecil on Thursday next, January 17th. Sir Eric Geddes states that he is willing to remain in office as president for another year.

Berlin Metal Workers' Lock-out.—A *Reuter* dispatch, dated Berlin, January 3rd, says that owing to the refusal of the metal workers there to agree to a proposed reduction in their wages the employers have locked out about 130,000 of them and work in some hundred Berlin metal factories is at a standstill. Negotiations are proceeding for a settlement of the dispute.

Lead Prices.—We have received from MESSRS. M. H. CAWSON, of 60, Gracechurch Street, London, E.C.3, a large chart showing the net monthly average market prices of soft foreign pig lead.

Chinese Industrial Mission.—*Reuter's* Agency learns that H.E. Chang Chien, Chinese Industrial High Commissioner, who is at the head of an industrial commission, comprising seven delegates, was expected to arrive in London this week. The Mission will spend a week in London, visiting the various industrial centres in the neighbourhood of the Metropolis and also conferring with leading business men. The object of the Mission is to investigate commercial and industrial methods in Europe. Since it left China it has studied conditions in France, Belgium, Holland, Germany, Austria, Switzerland, and Italy. During its visit to London the Mission will be entertained to luncheon by the British Government, to a luncheon by the Federation of British Industries, and at a banquet given in its honour by the Chinese Minister in London. The London programme will also include a reception by Chinese students, a reception at the Legation, and a luncheon by the London Chamber of Commerce. At the dinner given by the Chinese Minister, among the guests will be representatives of the Foreign Office, Department of Overseas Trade, Chamber of Commerce, China Association, &c. On leaving London the High Commissioner and the members of the Commission will make a tour of the provinces, and will finally leave on Wednesday, January 23rd, on the *Majestic*, to continue their investigations in the United States.

Sales Conference.—"Advertising" was announced as the subject of an address last night by Sir Harold Mackintosh and Mr. E. L. Fletcher at a sales conference organised by the E.D.A. Sub-committee at the Mechanics' Institute, Halifax.

Lead.—Reporting under date January 5th, Messrs. James Forster & Co. state: "There is little fresh business passing with consumers just at the moment, which is not unusual in the first week in January, when many are taking stock. It is anticipated, however, that there should be some good buying to be done before long, particularly by the cable trade."

Machine Tool and Engineering Exhibition.—The secretary of the Machine Tool Trades Association states that that body has already taken most of the space for the Third Machine Tool and Engineering Exhibition, which is to be held at Olympia from September 5th to 27th. On and after January 15th, however, any space still available will be offered to non-members for the display of suitable goods other than machine tools, small tools, and wood-working machinery, which may only be exhibited by members of the Association.—*Board of Trade Journal.*

Electrical Trousers Press.—The Commercial Secretary at Copenhagen (Mr. Richard Turner, O.B.E.) reports that he has been approached by a Danish firm of bespoke tailors who are desirous of getting into touch with British manufacturers of electrical machines for pressing the seams of trousers. Further information can be obtained from the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Reference No. 8513/F.R./C.C/(2).

Social Events.—A dinner was given on December 14th to the staff and workpeople of Chamberlain & Hookham, Ltd., by the directors, to celebrate the 40th year since the foundation of the firm and also the year in which the millionth meter was manufactured. The dinner was given in the Magnet Club at the Witton Works of the General Electric Co., Ltd., the details being carried out under the administration of Capt. Walton. About 620 sat down to dinner. Dancing followed, also a whist-drive. The musical programme was provided by the G.E.C. Band. A variety entertainment, including conjuring, was provided, and it was much appreciated by the junior members. Mr. W. S. Sprague, managing director, presided. He was supported by a small committee and many stewards. The other directors, Dr. Railing and Mr. Donald Hope, were prevented by indisposition from being present, but Mr. M. J. Railing attended in place of his brother, and addressed the gathering. During the proceedings a combined presentation was made to Mr. Sprague, to commemorate the event, from the whole of the staff and workpeople, and in addition special presentations from the Solar Works Social Club, the Angling Society, and the Football Club.

On the invitation of Mr. Robson, of Messrs. Robson and Coleman, of Newcastle-upon-Tyne, the staff and employés, with their wives, held their annual social evening on Friday last at the Minories Assembly Rooms. The company present numbered 130. After several hours at whist, supper was served and dancing and a second whist drive followed. The prizes for the first whist drive were presented by Mrs. Robson and for the second by Mrs. Lowrey. The apprentices who had come out highest in the results of technical education at the evening classes received prizes: L. Rutherford, £3 3s., three passes with distinction, and a free scholarship for next year's classes; H. Manuel, £2 2s., three passes, two with distinction and a scholarship; N. Hepplewhite and A. Mickler, £1 1s., each for two first-class passes. At the close a vote of thanks to Mr. and Mrs. Robson was heartily carried with musical honours. Music was provided by Mr. Davidsen's Maxe band.

British Empire Exhibition Note.—The Rochdale Electricity Committee recommends the Council to contribute £50 towards the electrical display at the exhibition.

Tradesmen Using the Royal Arms.—The *London Gazette* for January 1st contains lists of tradesmen in London and elsewhere who hold appointments to Royalty with authority to use the Royal Arms.

Management and Industry.—The series of lectures on this subject, at the Polytechnic, arranged in co-operation with the Industrial League and Council, will be resumed to-night in the Fyvie Hall of the Polytechnic at 8 o'clock. The lecturer will be Mr. James F. Butterworth, and his subject: "Motion Study and Fatigue Study: The Fundamentals of Economic Production." Other events in the course will be:—

February 8th.—"The Safeguarding of Health in Industry," by Dr. Edgar L. Collis, M.A., M.D., M.R.C.P.

February 22nd.—"The Economic Aspect of Cost Accountancy," by H. W. Allingham, M.I.Mech.E., &c.

March 7th.—"The Attitude of Labour to Problems of Industrial Organisation," by F. S. Button, J.P.

Lighting and Power Notes.

Amble.—INAUGURATION OF ELECTRICITY SUPPLY.—The Urban District Council's electricity scheme was recently inaugurated by the chairman of the Council, who switched on the supply. The current is obtained from the Newcastle Electric Supply Co. at 20,000 V, and is transformed down at the sub-station to 440 V for power and 250 V for lighting. The contractors for the whole scheme are Messrs. Graham Bros., of Middlesbrough, and the resident engineer is Mr. E. A. Anderson.

Bangor.—LOANS.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of the following sums:—£3,000 for mains and services; £1,000 for meters; and £846 in connection with the bulk supply scheme.

Barnstaple.—LOAN.—The Electricity Committee has recommended the purchase of a Browett Lindley engine, at an estimated cost of £2,000, and that application be made to the Electricity Commissioners for sanction to a loan to cover the expenditure.

Batley.—ELECTRICITY CHARGES.—The Town Council has adopted a recommendation of the Electricity Committee that, as an alternative to the present sliding scale, a flat-rate charge be made at the rate of 2d. per kWh for electricity for heating and cooking purposes.

Blackpool.—LOANS.—The Electricity Committee has received the sanction of the Electricity Commissioners to the borrowing of £17,400 for electricity purposes, and application is being made for sanction to a loan of £11,500 for additional plant.

Bognor.—WORKS EXTENSIONS.—The Bognor Gas Light and Coke Co. has now extensions in hand which will double the capacity of the power station. An order has also recently been placed for a new 6-cylinder Diesel oil engine.

Bridlington.—PROPOSED WORKS EXTENSION.—The Town Council has decided to obtain the advice of a consulting engineer as to the extension of the electricity works.

Bristol.—UNEMPLOYMENT SCHEME.—With a view to providing work for the unemployed, the Electricity Committee has obtained the approval of the Unemployment Grants Committee of a scheme for extending the existing 3-phase system along the main artery of Bedminster to Bedminster Down. The cost of the scheme is estimated at £16,601, and application is to be made to the Electricity Commissioners for sanction to the borrowing of this sum.

Colchester.—NEW POWER STATION.—The Town Council has received a report from Mr. W. C. C. Hawtayne, consulting engineer, on the proposed erection of a new power station. It is proposed to erect a new power station at Hythe and install two turbo-alternators with a capacity of 1,250 kW each, together with boilers and the necessary auxiliary plant. When the work on this station is well advanced, it is proposed to dispose of certain obsolete plant at the Osborne Street works to make room for converters to work in conjunction with the turbo-alternators at the new station. Provision will be made at the Hythe station for additional plant to meet future developments. An alternating-current supply will be given and transmitted at a pressure of 6,600 V. The estimated expenditure on the new generating station, equipment of Osborne street sub-station and feeder cables betwe-

the new station and sub-station is as follows:—Buildings, &c., £42,000; plant, including the dismantling and re-erection of existing plant, £69,370. Mains, including a.c. and d.c. cables between Hythe station and Osborne Street sub-station, £16,000; changing over supply in Lexden, Mile End and Bergholt districts, £7,500, making a total, together with the consulting engineer's fees, of £145,700. The Council has approved the report, and application is to be made to the Electricity Commissioners for sanction to the carrying out of the scheme.

Canada.—HYDRO-ELECTRIC DEVELOPMENT.—Sir Adam Beck, the Ontario Minister of Power, has announced plans for a large power development scheme on the St. Lawrence River, near Morrisburg, to be carried out in co-operation with the Provincial and Federal Governments. The scheme includes a dam, control works and development, which will cost from 75 to 80 million dollars, generating 350,000 h.p. for use in Ontario. The dam will raise the level of the water in Toronto Harbour by 2 ft. and in Montreal Harbour by 18 inches. The scheme will take five or six years to complete, and the power will serve Eastern Ontario. The carrying out of the scheme is dependent on the consent of the Dominion Government and the co-operation of the United States Government either directly or through a private company.—*Reuter* (Toronto).

Cheshire.—PROGRESS OF SUPPLY.—Under the Chester Electricity Extension (Special Order), 1923, the Chester Corporation has received powers to supply electricity in Cheshire over an area of about 72 square miles. The overhead transmission line to Blacon, Saughall, and Mollington has been completed, and a supply of electricity inaugurated to Blacon and Saughall. Within a few days the supply will be available at Mollington. This is the first section of the scheme to be carried out under the Special Order.

Clackmannanshire.—OPPOSITION TO ORDER.—The County Council has decided to oppose the application of the Scottish Midlands Electricity Supply, Ltd., for an Order to extend its area of supply so as to include certain districts in the county.

Croydon.—ELECTRICITY EXTENSIONS.—The Corporation has adopted a recommendation of the Electricity Committee for a provisional estimate of £90,500 for work to be carried out in connection with the electricity undertaking during 1924.

Darwen.—LOAN.—The Corporation is applying for sanction to borrow £14,357 for mains, services, and general distribution.

East Midlands Electricity District.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation an Order made by them constituting the East Midlands Electricity District and establishing the East Midlands Electricity Advisory Board.

Eastleigh and Bishopstoke.—ELECTRICITY SUPPLY.—Messrs. Preston & Co., of Wareham, have written to the Urban Council, on behalf of a client, offering to supply electricity to the town at a maximum price of 1s. per kWh, under a Special Order proposed to be applied for. The Council has replied, pointing out that the Southampton Town Council has already, with the consent of the Council, obtained a Special Order to supply the district with electricity.

Grampian Electricity District.—OPPOSITION TO ORDER.—At a recent meeting of the Forfar County Council it was decided to oppose the Grampian Electricity Order. A committee was appointed to consider and report upon the question of further proceedings, and it was also decided to try to secure the concurrence of Perthshire and Stirlingshire.

Hamilton.—CORRECTION.—The statement in our issue of December 28th that the Town Council had decided to take over the electricity undertaking, owned by Messrs. Edmundson's Electricity Corporation, Ltd., was incorrect. Messrs. Edmundsons inform us that negotiations are in progress for an extension of the agreement existing between them and the Town Council.

Ilkley.—LOANS.—The Urban District Council is applying to the Electricity Commissioners for sanction to the borrowing of £2,150 for the provision of a feeder cable to the Wheatley Lane area at Ben Rhydding; £1,000 for switchgear and plant; and £1,700 for additional expenditure in connection with the generating set which it is proposed to retain at the Council's works whilst purchasing a bulk supply from the Yorkshire Electric Power Co., Ltd.

Irish Free State.—THURLES (Co. TIPPERARY).—The electric lighting scheme is to be put in hand immediately, and will be financed by a loan of £5,000 and a local redeemable stock issue of £3,400.

BRAY (Co. WICKLOW).—The electrical engineer has submitted a report to the Urban District Council on the proposed scheme to introduce a new system of electricity supply in the district. The new scheme would involve the erection of two sub-stations, and the estimated cost is £13,600.

Kilmarnock.—YEAR'S WORKING.—The accounts of the burgh electricity undertaking (engineer, Mr. W. C. Bexon) for the year ended May 15th last show a total revenue of £99,487, as compared with £103,080 in 1921-22. Working expenses amounted to £42,835 (£66,559), leaving a gross profit of £56,652 (£36,521). After payment of capital charges, there was a balance of £3,427; there was a deficit of £3,087 on the previous year's working, leaving a net profit of £340. Expenditure on capital account during the year of £191,782, the largest items being £107,606 for machinery and £56,822 for mains. A total of 17,292,369 kWh of electrical energy was sold, an increase of 2,881,394, and the total number of consumers connected increased from 2,720 to 3,252.

Lancashire.—The Interim Advisory Board of the Mid-Lancashire Electricity District held its first meeting at Blackburn on January 9th.

Liverpool.—LOANS SANCTIONED.—The Corporation has received the sanction of the Electricity Commissioners to the borrowing of £45,000 for mains and £7,740 for the installation of a rotary converter.

London.—ISLINGTON.—The Borough Council has received the sanction of the Electricity Commissioners to the borrowing of £18,160 for mains, services, &c., and £28,000 for the installation of one 5,000-kW generating set at the electricity works at Holloway.

Manchester.—ELECTRICITY SUPPLY.—The output of the Corporation electricity undertaking for the month ended November 30th was 25.947 million kWh, an increase of 20.9 per cent. over the corresponding period of 1922, and the maximum demand was 101,580 kW, an increase of 14.1 per cent. This constitutes a record in the history of the department.

Additional plant capacity is required at a number of the sub-stations, and it has been decided to install one 2,500-kW motor converter and six 1,050/1,270-kW motor converters.

Northern Ireland.—LONDONDERRY.—The accounts of the electricity undertaking (electrical engineer, Mr. R. V. Macrory) for the year ended March 31st last show that after payment of interest and sinking fund, there was a net surplus of £6,230. The maximum load was 2,200 kW, and the total connections amounted to 6,546 kW. The number of consumers was 1,459, an increase of 278, and the total amount of electrical energy generated was 3,278,476 kWh. During the year a contract was placed with Messrs. A. Yarrow & Co., of Scotstoun, Glasgow, for two water-tube boilers. In view of the increasing demand for electricity, the electrical engineer has recommended the installation of a 3,000-kW turbo-alternator, and also the erection of a sub-station at Waterside.

BELFAST.—The Corporation is applying to the Electricity Commissioners for sanction to the borrowing of £4,555 for the installation of a water screen at the Harbour power station.

Preston.—PROGRESS OF NEW POWER STATION.—Progress is being made in the completion of the power station at Preston, and it is expected that the machinery in the new power-house, on the south bank of the Ribble, will be set in motion during the course of the present half-year. Four of the boilers and one of the turbines are in position, and preparations for the installation of the second and third turbines are in progress. Some delay has been occasioned by recent floods.

Price Reductions.—Reductions in the charges have been made in the following districts:—

SHREWSBURY.—Lighting: A reduction of 10 per cent.

PEMBROKE (Co. DUBLIN).—Lighting: A reduction of 1d. per kWh. Power: From 3½d. to 3d. per kWh.

MANCHESTER.—Lighting: Flat rate; from 6½d. to 6d. per kWh; sliding scale from £14 per kW installed, plus 2½d. per kWh to £14 per kW, plus 1½d. per kWh. Domestic power: Flat rate, from 2d. to 1½d. per kWh; Norwich system, from 30 per cent., on rateable value, plus ½d. per kWh to 20 per cent. on rateable value up to £100, and 10 per cent. thereafter, plus ½d. per kWh. Power: Restricted-hour supply, from 1½d. to 1¼d. per kWh; ordinary small consumers governed by scale of consumption, from 3d. to 1.20d. to 2.5d. and 1d. respectively. Special power consumers paying war surcharges: A reduction of 10 per cent. from war surcharges.

South Africa.—RIVERSDALE (CAPE PROVINCE).—A meeting of ratepayers recently voted an additional £4,000 for the electric lighting scheme, the total cost of which will be £10,000. It is hoped that a start will be made at an early date, and the scheme completed towards the end of the year.

JOHANNESBURG.—The Tramways and Lighting Committee proposes an expenditure of £44,500 on the installation of new converter plant. This is in addition to the scheme for the provision of turbo-generating machinery recently put in hand. It is estimated that by the time the new power station is in operation, the proposed additional converting plant will be required.

Torquay.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £86,738 for the following purposes:—Building work and crane, £11,168; mains, £20,500; generating and converting plant, £53,115; air extraction plant, £1,070; and work in connection with existing plant, £885.

West Riding.—NEW POWER STATION.—Work has recently commenced on the foundations for the large generating station which the Yorkshire Electric Power Co. is to erect at Ferrybridge, and which will ultimately cost £2,000,000. It is expected that contracts for the generating plant will be placed during the present month. The station will have a capacity of 150,000 kW, the first installation being about 30,000 kW. The initial section of the station, which will probably be completed within a year, will cost approximately £450,000. The turbo-alternators will be of 20,000 h.p. each. A 12,500-kW turbo-alternator is to be added to the plant of the company's power station at Thornhill in the coming spring, and when completed, the station will have a capacity of 50,000 kW. A scheme of mains extensions is contemplated by the company at an estimated expenditure of £450,000.

The North Metropolitan Electric Power Supply Company's Undertaking.

(*Concluded from p. 23.*)

As we have already shown, the company's area of supply is very extensive, and contains many small towns, besides a considerable number of individual consumers taking power for industrial purposes; consequently the mains constitute a very important feature of the undertaking. The feeder cables are all three-core, paper insulated, and lead covered, and were made for pressures of 30,000, 20,000, 10,000, and 3,000 volts; the highest pressure at present in use is 20,000 volts, but 30,000 volts will eventually be employed. All cables above 3,000 volts, except those laid in earlier days on the solid system, are single-wire armoured, with two compounded Hessian tapes under and two over the armouring; they are laid directly in the ground, with planks over them to give warning of their presence. The 3,000-volt cables, as well as the 415-volt distributors, are double steel tape armoured, with two laps of Hessian tape under and over the armouring, and these are laid in the ground without planks over them. The bulk of the cables were made for 10,000 volts, over 120 miles of this class having been laid. All the cables were supplied by the British Insulated and Helsby Cables, Ltd., who also made the pilot and telephone cables in connection with the feeder protection devices.

FIG. 14.—ELECTRICITY OFFICES AT HARPENDEN.

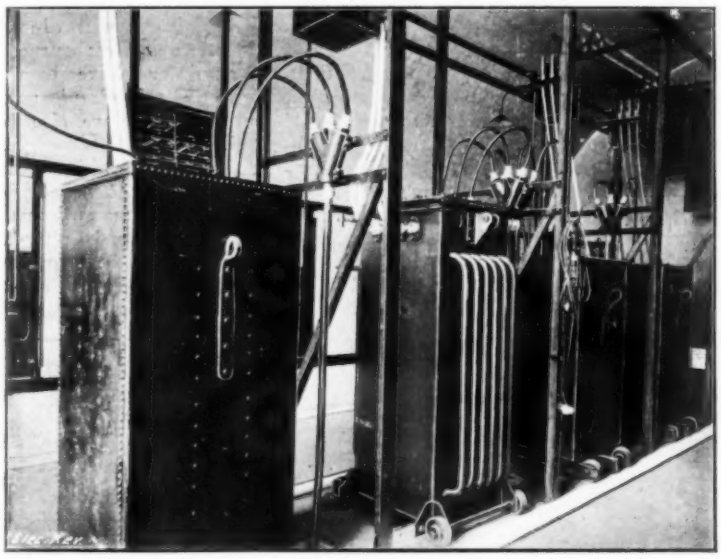


FIG. 11.—TRANSFORMERS AT BROXBOURNE SUB-STATION.

Overhead lines have been adopted in certain parts of the area, as shown on the map, fig. 4, and will be considerably extended in the near future, it being Captain Donaldson's intention to link up the chief centres with the equivalent of a ring main. The terminal of a double-circuit line starting near Brimsdown power station was shown in fig. 9, p. 22, one circuit of 0.1 sq. in. cross-section going to Chingford and the other, of 0.2 sq. in., to Ponder's End. Fig. 12 shows a similar terminal near Broxbourne sub-station, of a line carrying a single 0.1 sq. in. three-phase circuit. It will be noticed that in each case connection between the power station or sub-station and the overhead line is effected by means of a length of underground cable. Pin-type insulators are used throughout the system, and the pilot cable is slung from a messenger cable, as illustrated.

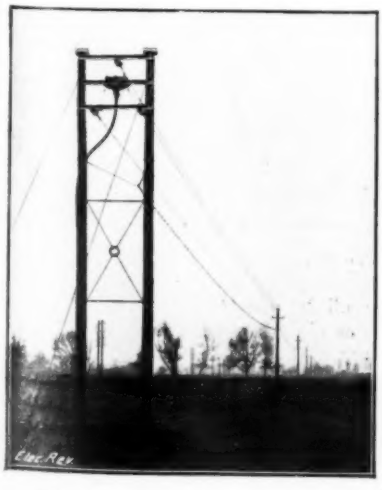


FIG. 12.—TERMINAL OF LINE FROM CHESHUNT TO BROXBOURNE.

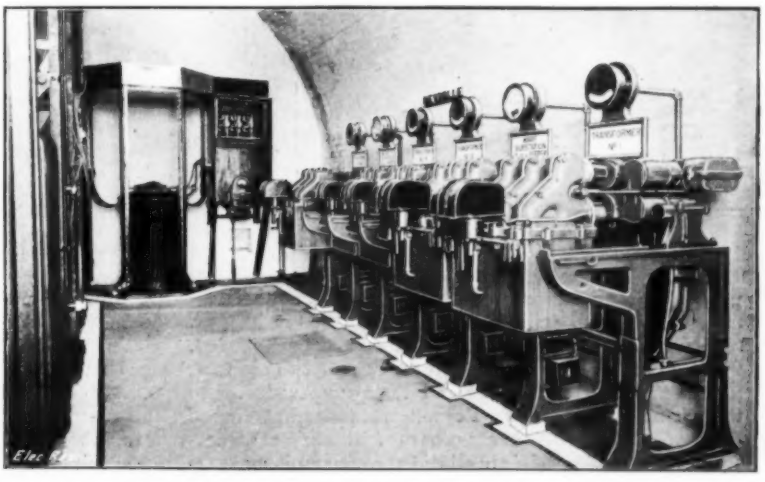


FIG. 13.—REYROLLE SWITCHGEAR AT BROXBOURNE SUB-STATION.

There are in all over 120 sub-stations connected to the mains, many of these being situated on the premises of large consumers. With the exception of those supplying direct current for traction, the sub-stations contain only transformers stepping down to 3,000 and 415 volts, with the necessary switchgear. Standardisation has been adopted as regards both output and ratio; the transformers, which were supplied by the British Electric Transformer Co., Ltd., are of three standard types, and the 3,000-volt switchgear, constructed by the company's staff, is reduced to the simplest elements, mounted on steel framework above the transformers. For 10,000 volts cubicle switchgear designed by the company's engineers is largely employed. Much of the 20,000 and 10,000-volt switchgear has been supplied by Messrs. A. Reyrolle & Co., Ltd., there being at Wood Green 20 panels with remote mechanical control and at the Hale five panels, with hand control, for 10,000 volts; six similar panels are installed at Broxbourne sub-station, fig. 13, controlling four transformers and two circuits, and as many at Churchbury and Tramway Avenue. All these panels are of Messrs. Reyrolle's standard armoured draw-out type, with the busbars and current transformers embedded in insulating compound and the mechanism completely interlocked. At Hatfield, the residence of the Marquis of Salisbury, one of the first mansions to be lighted with electricity, a sub-station containing 20,000-volt transformers and four panels of Reyrolle switchgear has been installed and the old private plant removed.

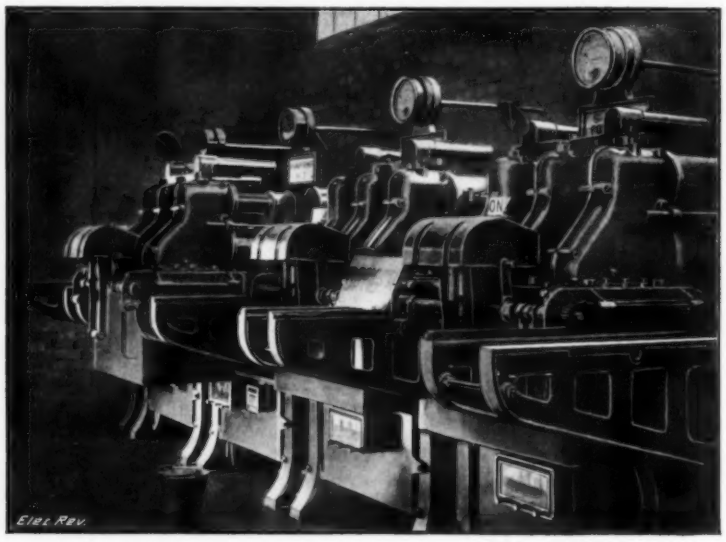


FIG. 15.—REYROLLE SWITCHGEAR AT HARPENDEN SUB-STATION.

The new sub-station at Harpenden presents some special features of interest. The local offices and showroom are accommodated in a house, fig. 14, which has been converted for the purpose; the illustration shows also one of the arresting signs which the company has posted at all suitable points, and on its vehicles, as well as on stationery, &c., with the object of impressing upon the public mind its slogan: "Use Electricity." Behind the house is the sub-station building, containing the switchgear shown in figs. 15 and 16, the former comprising four Reyrolle 20,000-volt panels. The transformers, however, whilst protected above and at the sides from the weather, have been left otherwise in the open, thus gaining the full benefit of natural ventilation at minimum expense (fig. 17).

The Merz-Price system of protection is employed on some of the company's feeders, overload with time limit and split-conductor feeder protection being also in use. In some sub-stations, as at Broxbourne, induction regulators have been installed on 3,000-volt circuits; auto-transformers with variable tappings have also been used. Some of the 415-volt circuits are thus controlled, but not many regulators are now in use at this pressure.

The company loses no opportunity of bringing its service before the eyes of potential consumers, by means of the illuminated signs above-mentioned, attractive literature (of which a well-conducted little quarterly magazine entitled "Use Electricity" is an effective feature), and above all by the provision of efficient offices at 14 centres, at eight of which there are showrooms. The company maintains an extensive organisation for wiring consumers' premises and attending to their needs, but also is ready to recommend competent contractors to clients and to give advice regarding their installations and equipment, with a view to ensuring good workmanship and satisfactory service. Its business is increasing at a pace which makes it

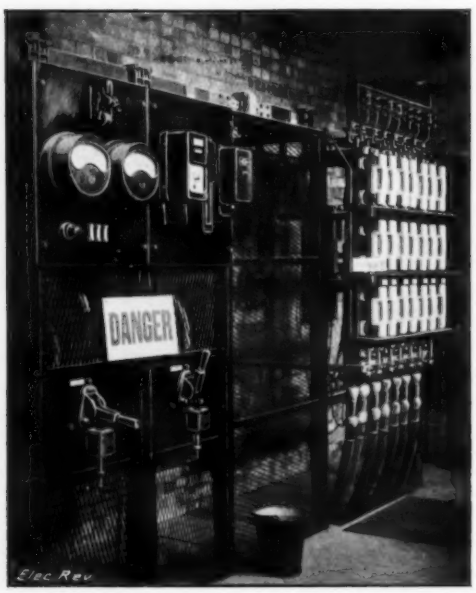


FIG. 16.—LOW-PRESSURE SWITCHGEAR.

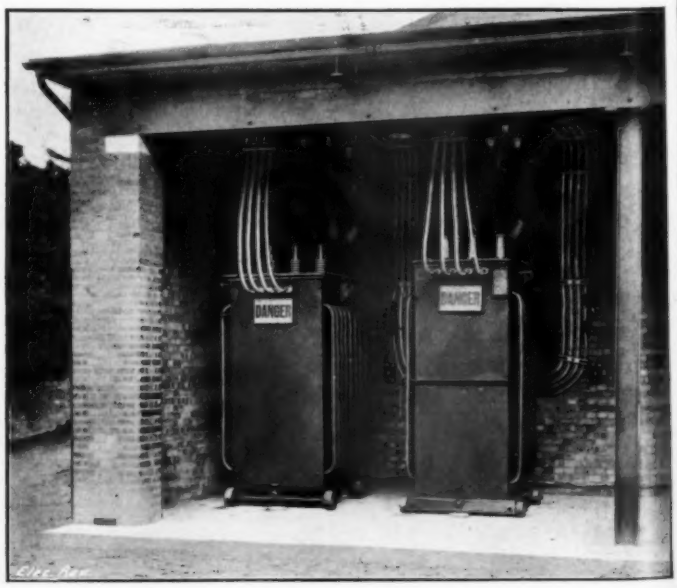


FIG. 17.—TRANSFORMERS AT HARPENDEN SUB-STATION.

difficult to lay mains and connect services quickly enough, and it is clear that there is in its area immense scope for future expansion and development.

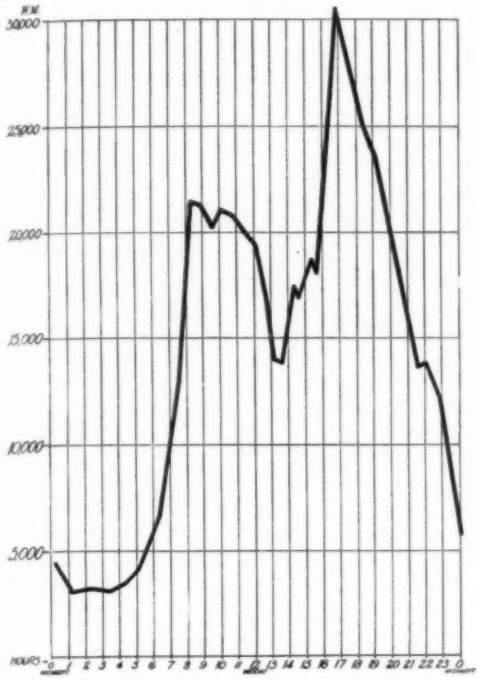
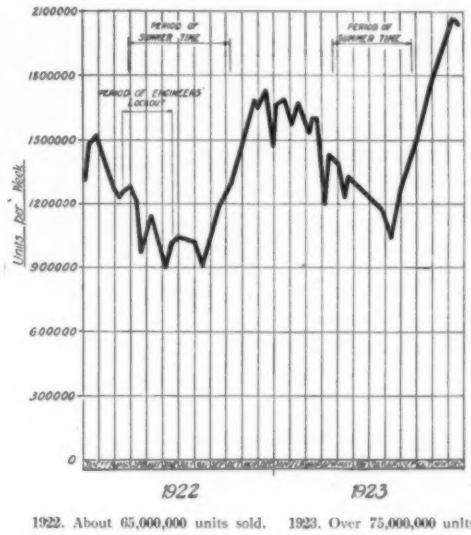


FIG. 18.—COMBINED LOAD ON WILLESDEN AND BRIMSDOWN POWER STATIONS, NOVEMBER 27TH, 1923.

The accompanying curves are of interest in this connection. Fig. 18 shows the load on the Brimsdown and Willesden power stations (which run in parallel the whole time), on Tuesday, November 27th, 1923. It will be seen that there is a heavy day load from 7.30 a.m. onwards, which is well maintained until past 9 p.m., the maximum load exceeding 30,000 kW. Fig. 19 shows the total units sold (not generated) per week during 1922 and 1923, clearly indicating the rapid development of the output. A gratifying increase in the sales took place towards the end of last year, which supports the view that trade is improving, and encourages us to look forward to still better results in the current year.

In concluding this brief sketch of some—by no means all—of the newer features of the company's undertaking, we have to thank the chief engineer, Capt. J. M. Donaldson, M.C., for affording us facilities to visit the works and sub-stations and to obtain the photographs which are here reproduced.



1922. About 65,000,000 units sold. 1923. Over 75,000,000 units sold.

FIG. 19.—TOTAL UNITS SOLD PER WEEK IN 1922 AND 1923.

Transformers for Very High Voltage Tests.

In view of the continuous progress towards the universal adoption of electricity for all purposes, it is necessary for British manufacturers to be prepared to design and construct plant, cable, and apparatus not only for the requirements of the Home market, but also for those of the export trade. The comparatively small

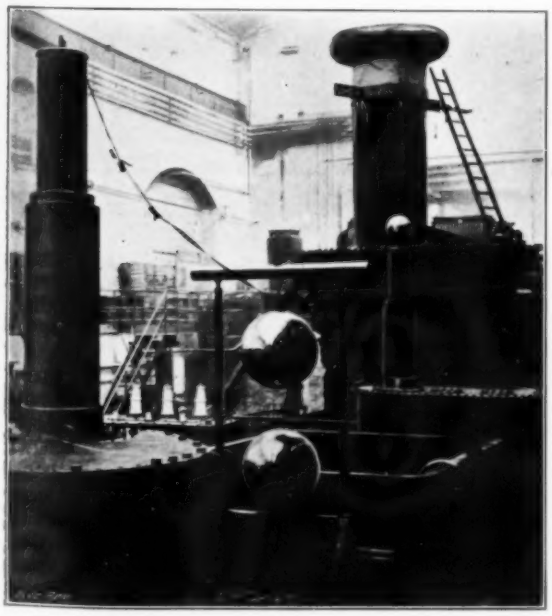


FIG. 1.—HIGH-VOLTAGE TESTING TRANSFORMERS UNDER CONSTRUCTION.

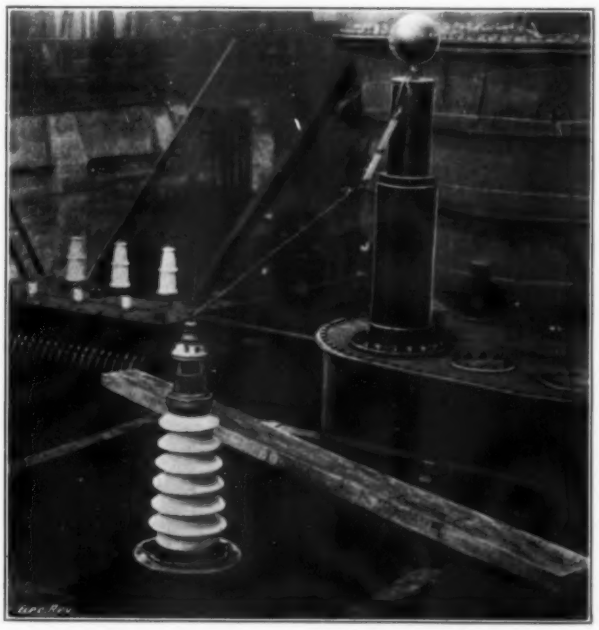


FIG. 2.—OIL-FILLED BUSHING FOR 66,000-V, READY FOR TEST.

area of Great Britain can be supplied with electrical energy at moderate voltages, but in countries oversea where waterfalls abound and long distances have to be covered, the transmission of electricity very often calls for pressures of 110,000 volts and upwards, and consequently three times these pressures are required for testing the apparatus. Although British manufacturers have had no opportunity of developing plant and apparatus of very high voltage for their Home markets, there are gratifying indications that they are keeping abreast of the times and are equipping themselves with the first essential, *i.e.*, the testing plant.

In the ordinary routine testing of cables and switchgear for 66,000-volt installations, the manufacturer requires from two to three times the working pressure, *i.e.*, 200,000 volts, and a similar pressure is required for the testing of insulators and insulating materials generally. The designing of switchgear necessitates even higher pressures, and one firm is just completing a very fine testing installation for 500,000 volts.

As an indication of the amount of work that is being done in this direction, we are informed that Messrs. Ferranti, Ltd., who have a very extensive experience in this class of work, are now manufacturing a number of high-voltage testing transformers aggregating two million volts. These include the following items:—For a switchgear manufacturer, 500,000 V; for a contractor, 200,000 V; for a supply company, 200,000 V; for an insulator maker, 300,000 V; for a switchgear company, 225,000 V; for a supply company, 100,000 V; for a cable company, 120,000 V. Other cable-making companies call for 50,000 to 65,000 V, and a Government department for 50,000 V, and several orders for 35,000 V have been placed, including one by a paper manufacturer.

FIG. 5.—FLASH-OVER BETWEEN ½-METRE SPHERES AT 400,000 V.

The accompanying illustrations are of interest as showing the types of testing transformers made by Messrs. Ferranti, and the effects produced by their operation. Fig. 1 shows three transformers in course of construction, those on the right being designed for 500,000 and 200,000 volts respectively, and that on the left for 200,000 volts. The polished spheres shown in this view are each 50 cm. in diameter—say 20 inches. Fig. 2 shows a 66,000-V oil-filled bushing ready for testing, and figs. 3 and 4 show it under test at 180,000 V (note the corona on the wire) and at 240,000 V, flashing over (dry) at the latter voltage. In fig. 5 is seen a flash-over at 400,000 v between ½-metre spheres, and in fig. 6 the much more spectacular display resulting from a discharge at the same pressure between points in air.

FIG. 3.—BUSHING UNDER TEST AT 180,000 V.

FIG. 4.—FLASHING OVER AT 240,000 V (DRY).

In the design of high-voltage transformers, Messrs. Ferranti, Ltd., have the advantage of intimate contact with Canadian experience through their factory in Toronto, and are fully informed as to progress on the American Continent generally. The construction that they have adopted is based upon long experience in this class of work. The first 110,000-volt power transformers built in Great Britain were made at Hollinwood for the New Zealand Government and fully tested there.

Difficulties in manufacture which seemed insuperable have been successively overcome; for example, the humid climatic conditions of Hollinwood are more severe than those of dry Switzerland or dry America, but the result is that a satisfactory test at Hollinwood ensures successful operation in any other climate.

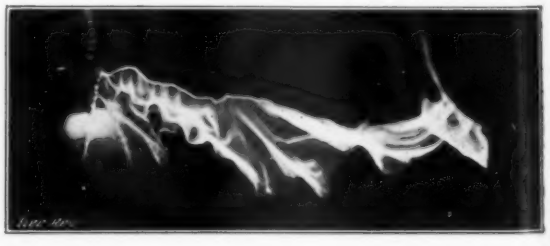


FIG. 6.—FLASH-OVER BETWEEN POINTS IN AIR AT 400,000 V.

The building of high-voltage testing transformers, which are oil-immersed in a manner similar to commercial transformers, has been of great value to the makers in connection with the design and manufacture of power transformers generally.

How great is the developing field for apparatus working at very high voltages was well shown in the report of the Paris Conference on extra-high-pressure transmission lines, which was published in our December issues. It was there stated that in America from 1,200 to 1,500 miles of line at a pressure of 110,000 volts were in operation; a large amount of work has been done at 220,000 volts, and already it is proposed to standardise 330,000 and 440,000 volts as the next stages in the ever-rising scale of pressures. It is imperatively necessary that British manufacturers should share in this new field, which, be it noted, is not a matter merely for the future, but is wide open to-day.

Tramway and Railway Notes.

Bradford.—POST BOXES ON TRAMCARS.—The Tramways Traffic and Fares Sub-Committee has approved a proposal from the local Postmaster for resumption of the pre-war arrangement of letter-boxes on the evening tram-car service. The general manager has been authorised to restore the facility on terms of payment by the Post Office at the rate of £2 per box per annum.

Continental.—FRANCE.—Rapid progress is being made on the work of conversion to electric traction of the State railway lines in the outskirts of Paris. The first section was to have been opened in October last year, but it has since been deferred till March next. The next section—that of Paris-Bois-Colombes—will be opened at the same time. The dates for the opening of the other sections are as follow:—Paris-Becon les Bruyères, March, 1924; Paris-Saint Germain, August, 1925; Paris-Versailles (Rive Droite), December, 1926; Paris-St. Nom la Bretèche, 1926; Bois Colombes-Argenteuil, 1927. The generating stations at Nanterre and Issy-les-Moulineaux, equipped with four 5,000-kW groups each, and the sub-stations at Champ-de-Mars, Porchefontaine, Bois de Boulogne, and Meudon are already in use. The sub-stations at Pont Cardinet, Asnières, Suresnes-Puteaux, and Garenne are complete; but those at Chatou St. Germain, Quest Ceinture, and Argenteuil are in course of construction. The plans of the sub-stations at Bougival and St. Nom la Bretèche have received official approval, while the Ministerial consent is awaited in the case of those at Sceaux, Massy, and Orsay. Of the rolling stock, 50 motor-cars are on order, and two orders of 30 trailers each, and one of 10 trailers, have been placed. Delivery of the cars has been begun, and the rest are to follow at the rate of 4 per month. The cars weigh 57 tons, and have seating accommodation for 84 passengers.

GERMANY.—The scheme for the construction of an electric railway from Hamburg to Genoa will shortly be put in hand. When this scheme is completed work will be commenced on the electrification of the main lines for the through North-South traffic, and more particularly the stretches from Basel to Frankfort-on-the-Main and Karlsruhe-Stuttgart-Ulm. In the years 1924 and 1925, Geneva, Lausanne, Bern, and Lucerne will be linked up with Basel by electric lines.

SPAIN.—Work will shortly commence on the construction of an electric railway between Tortosa and Gava.

London.—COLLISIONS.—A collision occurred on December 31st between two tramcars in Walworth Road. The front car pulled up abruptly in order to avoid running into a motor-van, and the car following ran into it. The back of the front car was smashed and the windows broken. Four persons received slight injuries from broken glass.

A collision also occurred between a tramcar and an omnibus at Park Street, Bermondsey, on January 3rd. The windows were shattered, but none of the passengers were injured.

L.C.C. TRAMWAY EXTENSIONS.—The City of London Corporation has withdrawn its opposition to the London County Council's proposal to extend the tramway track over Southwark Bridge.

Manchester.—NEW ROUTES.—The Tramways Committee intends to push forward the construction of tramways in Wilbraham Road and Birchfields Road, and thus provide work for an additional 150 men for several months.

Northern Ireland.—BELFAST.—The Corporation has decided to lay a tramway track along Chichester Street and to extend the lines as far as Dundonald Cemetery at a cost of £31,913.

Oldham.—RAILLESS CARS.—At a special meeting of the Town Council, on the 2nd instant, it was decided to include in the Parliamentary Bill to be promoted in the ensuing session provision empowering it to run railless cars in the borough.

Queensbury.—OBJECTION TO RAILLESS CARS.—The Urban District Council has agreed to enter an objection to the proposal of the Bradford Corporation to secure powers for running railless cars within the district.

Torquay.—LIGHT RAILWAY.—The Minister of Transport has made the Babbacombe Cliff Light Railway Order, 1923, authorising the construction of a light railway in the borough.

Worcester.—LIGHT RAILWAY.—The draft of the Worcester and Broom (Light) Railway Order, 1923, with the deposited plans, and an estimate of expenses, have been considered by the General Purposes Committee. The town clerk pointed out that the Order included clauses enabling the local authorities along the route to advance money towards the cost of constructing the line—as regards the City Council, the sum of £20,000. The surveyor presented a report of his examination of the deposited plans so far as they relate to the portion of the railway in the city. The Committee decided to recommend the City Council to approve the general idea of the railway, subject to consideration of the details of the scheme, and that in the meantime notice be given of the Council's dissent from its property being taken or interfered with for the proposed railway.—*Electric Railway & Tramway Journal.*

Radio Notes.

Long-distance Reception.—On December 29th the programme of the London broadcasting station was heard at Middelburg (Cape Province), South Africa, from 10.50 p.m. to 2.10 a.m. The distance is about 5,000 miles. As South African time is two hours ahead of London time, it follows that the programme broadcast from Pittsburgh, U.S.A., received in Kent and relayed to London, whence it was simultaneously broadcast to all British stations, was received in South Africa, having thus travelled over a distance of about 8,000 miles in all. Whilst this was doubtless a "freak" performance, it constitutes a world's record.

American amateurs have succeeded in communicating with the s.s. *Bowdain*, a vessel which is exploring off the West Coast of Greenland, at a distance of some thousands of miles.

Proposed Plymouth Station.—The British Broadcasting Company states that the whole question of relay stations is now receiving its earnest attention, and that it hopes to come to an early decision with regard to the proposed Plymouth station. It is understood that one of the company's chief engineers will pay a visit to Plymouth shortly in order to inspect suggested suitable sites for the station.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Aberdeen.—January 14th. Town Council. Electric lighting installation at four blocks of houses, each containing 12 dwellings. Mr. James Coutts, Housing Department, Town House, Aberdeen.

Argentina.—BUENOS AIRES.—March 21st. State Oilfields Administration. Construction of electric power station of 15,000 h.p. at Comodoro, Rivadavia.*

Australia.—MELBOURNE.—February 11th. Electricity Commission. Four 100-kVA, 25,000-6,000-V transformers and spares. (December 21st.)

SYDNEY.—March 3rd. Harbour Trust Commissioners. For two 3,000-ft. lengths of electric submarine cable.—*Reuter's Trade Service* (Melbourne).

SYDNEY.—February 18th. Municipal Council. Distribution transformers, 59 (5,000/415 V) and 35 (10,000/415 V). Messrs. Preece, Cardew & Rider, London.

Bridlington.—January 14th. Electricity Department. One 30 ft. by 7 ft. 6 in. Lancashire boiler. (December 28th.)

Canterbury.—January 14th. Electricity Department. L.p. lead-covered armoured feeder cable. (December 28th.)

Chesterfield.—January 15th. Joint Hospital Committee. Electric lighting installation, Penmore Isolation Hospital. Manager, Corporation Electricity Department.

Clacton.—January 16th. Electricity Department. One 750-b.h.p. Diesel oil engine, direct coupled to a 500-kW, d.c. dynamo. (January 4th.)

Derby.—January 15th. Electricity Department. One 1,000-kW motor-converter, or alternatively one 1,000-kW rotary converter. (January 4th.)

Denmark.—COPENHAGEN.—February 12th. Lighting Department. Transformer plant.*

February 13th. Turbo-generator plant and accessories.*

Dreghorn (Co. Ayr).—January 14th. Electric lighting of 10 houses being erected at Townfoot, for the Northern District Committee of the Ayrshire C.C. Messrs. J. & J. Armour, architects, Irvine.

Dublin.—January 26th. Electricity Department. E.h.p. switchgear and accessories. (See this issue.)

January 25th. 5,000-kW generating set, condensing plant, steam and water piping, &c. (See this issue.)

Egypt.—CAIRO.—March 1st. The Director-General, Section of Municipalities and Local Commissions, Savoy House, Cairo Supply and installation of a hydro-electric station, a transmission line and distributing poles in the town of Fayum.

CAIRO.—The Director-General, Section of Municipalities and Local Commissions, Savoy House, Cairo, invites tenders closing on the dates mentioned as follows:—

March 20th.—Supply and installation of electrical works and system at Benha.

March 27th.—Supply and installation of electrical works and system at Chebin el Kom.

April 3rd.—Supply and installation of electrical works and system at Miniet el Kamh.

April 10th.—Supply and installation of electrical works and system at Beni-Mazar.

Reuter's Trade Service (Cairo).

Grimsby.—February 4th. Electricity Department. E.h.p. switchgear. (January 4th.)

Hastings.—January 21st. Electrical Department. Steel constructional work, coal bunkers and chutes, reinforced concrete pond and plant foundations. (December 28th.)

Keighley.—January 14th. Electricity Department. Two 30,000-lb. water-tube boilers, stokers, economisers, bunkers, and fans. (December 28th.)

London.—FULHAM.—January 16th. Electricity Department. Two 6,000-kW, 3-phase turbo-alternators; three h.p. water-tube boilers, with economisers, stokers, soot blowers, &c. (December 28th.)

ISLINGTON.—January 30th. Electricity Department. Twelve months' supply of electrical and engineers' stores, including cables, meters, transformers, globes, lamps, electrical sundries, &c. (December 28th.)

CAMBERWELL, S.E.—January 28th. Borough Council. Maintenance for 12 months of electric lighting, heating, and power installations, telephones, &c.

Twelve months' or, alternatively, 6 months' supply electric lamps. Specifications from Mr. W. J. Bell, borough engineer, Town Hall, Camberwell, S.E.

LONDON COUNTY COUNCIL.—January 21st. Three 2,000-kW rotary converters, static transformers, and accessories. (January 4th.)

BERMONDSEY.—January 24th. Electricity Works. Twelve months' supply of stores, including cable, conduits, meters, lighting and wiring accessories, &c. (January 4th.)

ISLINGTON.—January 24th. Board of Guardians. Installing electric lighting at the relief station, dispensary, &c., at Liverpool Road, Islington. (See this issue.)

WEMBLEY.—January 26th. Department of Overseas Trade. Supply and fixing of armoured sub-main cables in H.M. Government Building at Wembley. Specifications from the Electrical Engineer, Room 517, War Office, Whitehall, S.W.1.

January 30th. Metropolitan Asylums Board. Installation of a 144-tube economiser; new continuous drying machine; engineering work for new central boiler house; revising laundry engineering arrangements and installing electric light and power wiring in boiler house and laundry. (See this issue.)

New Zealand.—WELLINGTON.—May 23rd (extended from April 30th.) Public Works Tender Board. Arapuni electric power scheme (Section 2, power house and plant). Design, manufacture, supply, erection, testing, and maintenance for a period of six months of hydro-electric power station at Arapuni on the Waikato River, including machinery and plant, outdoor step-up transformer station, buildings, and all accessories.*

Redcar.—January 17th. Town Council. 3,700 and 4,000 yd. cable for proposed electricity scheme. Mr. R. McLean, Town Clerk.

Rumania.—CONSTANTZA.—January 25th. Tenders are invited for a 50-year electric lighting concession; also for the construction of tramways in the city and its outskirts. Particulars, Hotel de Ville, Constantza, Rumania.

South Africa.—JOHANNESBURG.—February 28th. Turbo-generator plant and accessories.*

March 8th. Electricity Supply Commission. Tenders for the establishment and working of a proposed undertaking for the supply of electricity to the railways in the neighbourhood of Cape Town. (See this issue.)

March 8th. Electricity Supply Commission. Electrification of South African railways. Plant required in connection with the supply of electricity to the railways in the neighbourhood of Cape Town:—Steel-frame buildings for power station; boiler-house equipment; coal- and ash-handling plant; turbo-alternators; condensing plant; power-station switchgear; sub-station swichgear; transformers for step-up sub-station and power station; sub-station equipment; cables. (See this issue.)

March 8th. South African Railways and Harbour Board. Electrification of Cape Town and Simonstown lines, motor bogies and electrical equipment of coaches. (See this issue.)

Wallasey.—January 18th. Electricity Department. Thirty air-cooled transformers. (January 4th.)

Yoker.—January 14th. Renfrew County Council. Electric lighting installation at 60 houses, Yoker Road, Yoker. Mr. James M. Dow, architect, County Buildings, Paisley.

York.—January 16th. Electricity Department. Two 25,000-lb. water-tube boilers, economisers, steam pipes, feed pumps, &c. (December 21st.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Aldershot.—Town Council. Accepted:—
Electric light cable (£214).—W. T. Henley's Telegraph Works, Ltd.

Barnstaple.—Town Council. Accepted:—
Wiring premises for electric lighting.—Taw Shipyards, Ltd.

Belfast.—City Council. Accepted:—
Extension of electric tramways in the city (£31,912).—Messrs. John Graham and Co.

Derby.—London, Midland & Scottish Railway Co., Central Stores Department (Midland Division).
Supply of gasfilled lamps for a portion of the supplies for a period of 6 months from January 1st to June 30th, 1924.—Metropolitan-Vickers Electrical Co., Ltd.

Edinburgh.—Tramways Committee. Recommended:—
20 top-covered car bodies (£16,000).—English Electric Co., Ltd.

London.—According to various Press reports, the Underground Electric Railways Co. of London, Ltd., has divided contracts of a total value of £765,000 between four of the leading iron and steel structural firms in Great Britain for no fewer than 85,000 tons of cast-iron tunnel segments. *Modern Transport* states that to John Cochrane & Sons, Ltd., civil engineering contractors, of Westminster, has been awarded the order for 60,000 tons of cast-iron segments required for the enlarging of the tunnels on the southern section of the City and South London Railway. The value of this contract amounts to no less than £540,000. In addition, contracts, valued at £225,000, for the remaining 25,000 tons of segments to be used for the new extension of the Hampstead and Highgate Railway, which is about to be constructed from Charing Cross to Kennington, *via* Waterloo, have been divided between three other firms.

WAR OFFICE.—Accepted:—
1,112 ammeters and voltmeters.—Park Royal Engineering Works, Ltd.

BATTERSEA.—Electricity Department. Accepted:—
Three e.h.p. feeder cubicles.—Park Royal Engineering Works, Ltd.

LONDON & NORTH-EASTERN RAILWAY CO. Accepted:—
12 months' supply of signal repeaters, relays, &c.—Park Royal Engineering Works, Ltd.

GREAT WESTERN RAILWAY CO. Accepted:—
60 distant switches.—Park Royal Engineering Works, Ltd.

MARYLEBONE.—London & North-Eastern Railway (Great Central Section). Accepted:—
Gasfilled and train-lighting lamps for twelve months ending December 1924.—Metropolitan-Vickers Electrical Co., Ltd.

Royal Mail Steam Packet Co. Accepted:—
Part contract for the supply of metal- and carbon-filament lamps for the 12 months ending December 31st, 1924.—General Electric Co., Ltd.

Great Northern Railway. Accepted:—
Supply of traction lamps, gasfilled lamps, and special lamps for the 12 months ending December 31st, 1924.—General Electric Co., Ltd.

Aberdeen Line. Accepted.—
Supply of electric lamps to the steamers of the company for six months ending June, 1924.—Siemens and English Electric Lamp Co., Ltd.

Liverpool.—Booth Steamship Co., Liverpool (Cunard and Anchor Lines). Accepted:—
Supply of Osram lamps during the 12 months ending December 31st, 1924.—General Electric Co., Ltd.

Reigate.—Town Council. Accepted:—
Two pumps for the generating station (£272).—John Wolstenholme & Son, Ltd.
Electric light wiring and fittings, Old Town Hall.—J. E. Goundry.

Rugby.—Board of Guardians. Accepted:—
Installing electric lighting at the Institution.—Rugby Electrical Engineering Co. (Mr. S. E. Marsh).

Spennymoor.—Urban Council. Accepted:—
Supply and fixing of electric radiators in the Council chamber.—Edwards Bros.

Forthcoming Events.

Electrical Contractors' Association.—Tuesday, January 15th. At the Hotel Cecil, W.C. At 6.30 p.m. Annual dinner.

Paisley Association of Engineers.—Tuesday, January 15th. At 30, High Street. At 7.30 p.m. Lecture on "The Application of Searchlight Projectors," by Mr. L. G. Toplis.

Greenock Association of Electrical Engineers.—Wednesday, January 16th. At 22, West Stewart Street. At 7.45 p.m. Open night.

Institution of Production Engineers.—Wednesday, January 16th. At the Engineers' Club, Coventry Street, W. At 7.30 p.m. Paper on "Accuracy in Production Engineering," by Messrs. J. E. Baty and A. J. C. Brooke.

Junior Institution of Engineers.—Wednesday, January 16th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Presidential address by Sir J. Fortescue Flannery, Bart., on "Marine Propulsion During Fifty Years."

Friday, January 18th. At 39, Victoria Street, S.W. Lecturette, "The Liability of Employers in respect of Personal Injuries to their Workmen," by G. F. Tyler.

Institution of Electrical Engineers.—Thursday, January 17th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "Electric Passenger Lifts," by Mr. H. Marryat.

(North-East Centre).—Monday, January 14th. At Armstrong College, Newcastle-on-Tyne. At 7.30 p.m. Paper on "Pulverised Fuel and Efficient Steam Generation," by Mr. D. Brownlie.

(Irish Centre).—Thursday, January 17th. At Dublin. Paper on "Oil Engines," by Mr. C. Day.

(South-Midland Centre).—Wednesday, January 16th. At the University, Birmingham. At 7 p.m. Lecture on "Railway Electrification in Foreign Countries," by Dr. S. P. Smith.

(Mersey and North Wales (Liverpool) Centre).—Monday, January 14th. At the University, Liverpool. At 7 p.m. Lecture on "Some Researches on the Safe Use of Electricity in Coal Mines," by Prof. W. M. Thornton.

(Sheffield and District Sub-Centre).—Wednesday, January 16th. At the Royal Victoria Hotel, Sheffield. At 7.30 p.m. Paper on "What is Electricity?" by Mr. H. E. Yerbury.

Manchester Electro-Harmonic Society.—Friday, January 18th. At the Albion Hotel, Piccadilly, Manchester. At 7.30 p.m. Concert.

British Electrical Development Association.—SALES CONFERENCE.—Friday, January 18th. At the London School of Economics. At 7.30 p.m. Paper on "How to Market Hot Water for Domestic and Heating Purposes," by Mr. C. G. Nobbs.

Edinburgh Electrical Society.—Friday, January 18th. At the Philosophical Institute. At 8 p.m. Paper on "The Windings of Direct-current Machines," by Mr. R. Leishman.

Belfast Association of Engineers.—Saturday, January 19th. At the Municipal College of Technology. At 7.30 p.m. Paper on "Steam Generators," by Mr. I. Poots.

The "Electrical Review" Service Department.

Inquiries must be accompanied by a stamped addressed envelope.

We should be glad to learn the names of makers or suppliers of:—

PALATINE hair dryers, vibrators, &c.

Notes.

The Royal Air Force.—The Air Ministry announces that 400 officers for flying duties, under the short-service commission scheme, are required during the current year. Particulars and application forms can be obtained from the Secretary, Air Ministry, Adastral House, Kingsway, W.C.2.

The Electro-Harmonic Society.—At the smoking concert which is to be held in the Caxton Hall, Westminster, to-night, Friday, at 8 o'clock, Mr. Percy Rosling will take the chair. The artistes will be:—Mr. Walter Glynne, tenor; Mr. David Openshaw, baritone; Mr. Joseph Bull, operatic banjoist; Mr. Morland Hay, songs at the piano; Mr. Emil Clare, humorist; M. Alec Chentrens, Anglo-French comedian; Mr. Fred Wildon, "phonofiddleoddities"; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

Scientific Novelties Exhibition.—The exhibition of scientific novelties arranged recently at King's College, in aid of King Edward's Hospital Fund for London, was on similar lines to the exhibition which was held this time last year. Electrical novelties, of course, occupied a prominent position, and the demonstrations, while no doubt familiar to most of our readers, were of a mystifying nature to the general public for whom they were arranged. Prof. Ernest Wilson showed a number of experiments with high-pressure discharges, obtaining some very startling effects. Electric welding and the effects of rotating fields were demonstrated. Mr. W. M. Mordey performed a number of interesting experiments in alternating magnetism similar to those which he presented at the British Association meeting in September last. Another exhibit was the "Low-Hilger" audiometer, which we are describing in connection with the Physical Society's exhibition held last week. Demonstrators from the Northampton Polytechnic Institute showed the effect of an electric discharge through a tube in process of exhaustion, a very wonderful display from the spectacular point of view. They also experimented with X-rays. Other physical demonstrations and exhibits included the microphonic jet; travelling sparks from an induction coil, with two parallel vertical wires attached to its terminals; oscillations in neon tubes; thermionic valves; discharges through gases and cathode ray tubes; stream line filters; centrifuges, &c.

Messrs. Siemens Bros. & Co., Ltd., had a small automatic telephone exchange, by means of which this system of telephony was demonstrated.

Many lectures were given during the exhibition. Among them were "Radium and X-rays," by Professor Sidney L. Russ, D.Sc., and "Wireless at Sea," by Commander J. A. Slee, C.B.E.

A French Water-Power Exhibition.—A "White Coal" exhibition is to be held at Grenoble in the course of the year 1925 under the auspices of the city and of the local Chamber of Commerce.

Radio Direction-finding at Sea.—A device which utilises radio broadcasting to eliminate the danger of ship collisions in fogs has been added to the equipment of the marine gyro-compass, according to an announcement by the Sperry Gyroscope Co. When a ship equipped with a gyro-compass runs into a fog the radio broadcasting device on the compass will announce at intervals of a few seconds the ship's call letters, its course, and the word "gyro." Changes in course will also be announced so that navigators of ships within a few miles of the sending vessel will be able, by means of their direction finders, to keep in touch with its exact position. The broadcaster, it was stated, will announce the course of the vessel within an accuracy of five degrees, and will use an international code.—*Reuter's Trade Service* (New York).

Direction finding by radio apparatus was first attempted from ships in 1912. The matter fell into abeyance during the war, but the Marconi Co. made a fresh start in 1919, and there are now over 100 British merchant vessels fitted with the Marconi marine direction finder and nearly as many vessels sailing under foreign flags carrying the same apparatus. A record of observations shows that less than 10 per cent. of them are more than 2 deg. in error, and that less than 20 per cent. of them are more than 1 deg. in error. This degree of constancy has made it possible to define some of the areas in various parts of the world in which radio direction-finder bearings are inherently doubtful owing to natural causes, such as the shape of the land in the immediate vicinity of the transmitting station. When these known effects are allowed for, the percentage of accuracy becomes even higher.

The method of transmitting signals in a definite direction so that any ship hearing the signal will know her bearing from the point of origin is in operation at Inchkeith, in the Firth of Forth, and a second station is now being erected at the South Foreland lighthouse. This method necessitates the use of a very short wave (just over six metres) and special receivers. Thus, this method, which is called the "wireless beam," is absolutely independent of the ship's main transmission and reception apparatus, and it is unnecessary to employ a skilled telegraphist to read the signals; the accuracy of the bearing obtained is within 2 deg. At present it is only possible to use this method over comparatively short ranges, the original station at Inchkeith being reliable at 10 miles, and the new station at South Foreland is being designed for a range of 20 miles.

A Non-Technical Explanation of "Power Factor."—We learn from Mr. R. Amberton, of the Electrical Apparatus Co., Ltd., that owing to the very considerable number of explanations which have been submitted, Mr. S. T. Allen (the adjudicator) has not been able to judge the competition in time to publish the results in this week's REVIEW. It is hoped, however, that it will be possible to announce the results next week.

Appointments Vacant.—Plumber-Jointer (78s. 4d.), for the Stoke Newington Borough Council electricity department; chief assistant, for the electrical engineering department, Finsbury Technical College; cost clerk (£200), for the Stoke Newington Borough Council electricity department. (See our advertisement pages to-day.)

Damage Caused by Mouse.—Aberdeen Town Council has received a report stating that it will cost from £1,700 to £1,800 to repair damage caused at the main generating station by a mouse, which entered one of the e.h.p. cubicles, causing a short circuit. As a consequence the city was in darkness for about 35 minutes, and tramway traffic and electric power in factories cut off. The dead mouse was found in a wrecked cubicle.

The Electrical Performance of Traction Motors.—The British Engineering Standards Association has just published a Specification (No. 173/1923) for the Electrical Performance of Traction Motors (Direct Current, Series Wound), this being one of the series of six specifications which supersede B.S.S. 72/1917 now withdrawn. This specification keeps closely in line with the "Rules for Traction Motors" of the American Institute of Electrical Engineers. The British standard rating of a traction motor is a nominal rating, the temperature rises specified affording a basis of comparison between motors of similar construction. An appendix has been added containing notes on the temperature tests specified, and on certain features governing the temperatures of the motors in service, which should prove useful to the purchaser of British standard traction motors. Copies of this publication may be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, S.W. Price 1s. 2d., post free.

A New Photo-Electric Effect.—Dr. Irving Langmuir points out, in a recent issue of *Science*, that a study of some vacuum tubes containing caesium vapour has shown a peculiar photo-electric effect. The action of white light on an adsorbed film of caesium on nickel seems to cause this surface to reflect elastically electrons which are made to impinge on it. The number of electrons that can be thus reflected is proportional to the intensity of the light.

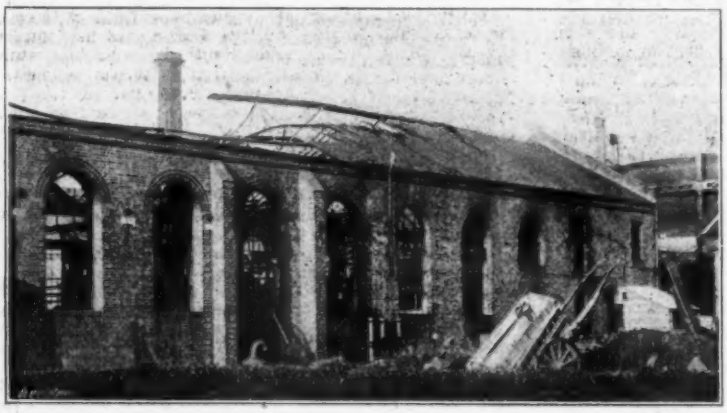
The relationships are in many ways analogous to those in electron tubes where the current is in general limited either by emission from the cathode or by space charge, depending upon which limit has the lower value. Similarly, it may be assumed that the photo-electric reflection may be limited either by the number of electrons that strike the electrode, or by the amount of light reaching the electrode. Although all the characteristics of this effect are not yet understood, it seems safe to assume that the effect is caused by an activation of an adsorbed caesium film by light, the atoms in this film being brought to such a state that they cause the impinging electrons to make elastic collisions.

A sharp distinction between the new photo-effect and the normal effect is that the new effect disappears entirely if a piece of red glass is interposed in front of the light source. It is probable that the effect is mainly due to light having a wave length of about 5,300 A units (blue-green). A similar activation of a nickel surface causing electron reflection has also been found in connection with some measurements of the distribution of velocities of electrons in the positive column of the mercury arc, by a method like that described recently by the same investigator, for measuring positive ion currents. By introducing high-speed electrons (40 volts) into the mercury arc by means of a heated negatively charged tungsten filament, it was found that the ability of a small collecting electrode (1 sq. cm. area) to take up low-speed electrons was greatly impaired.

Educating the Public.—Mr. W. Blair Smith, the Paisley electrical engineer, has recently delivered a series of public lectures upon the burgh's electricity supply undertaking. The object of the lectures was to give the townspeople some idea of the working of the system of which they are the proprietors. With the aid of numerous lantern slides, Mr. Smith explained the processes of power generation from the handling of the fuel to the working of the consumer's meter. He showed how an increase in the consumption and the levelling of the load curves enabled the price of energy to be reduced.

An Electrically-lighted Football Ground.—Upon the occasion of a football match between two ladies' teams recently, the Burnley Cricket Club ground was illuminated with electric lamps by the Siemens & English Electric Lamp Co., Ltd. Eleven 30-ft. wooden poles were erected along each side of the ground, spaced 33 ft. apart, and four similar poles were erected at each end. The side poles carried "Benjamin" angle parabolic reflectors mounted at the top and fitted with 1,500-W "Siemens" gasfilled lamps. Five feet lower down "Benjamin" elliptical angle reflectors and 500-W gasfilled lamps were fitted. The end posts had "Benjamin" concentrating type reflectors with 1,500-W lamps fitted at the top. The result was very good, the illumination being of the value of 7 ft.-candles all along the touch line, 2½ ft.-candles 30 ft. from the posts, 2 ft.-candles 60 ft. in, and 0.5 ft.-candle in the centre of the field. There was an entire absence of glare and shadows.

Destruction of Clacton Power Station.—On January 4th the municipal power station at Clacton-on-Sea was totally destroyed by an outbreak of fire. Oil fuel was being pumped into the station tanks, and owing to its heavy condition was heated by a gas jet. The oil overflowed the tanks, and was ignited by the gas jet causing a tremendous conflagration. By the efforts of the fire brigade the flames were prevented from reaching the main storage tanks, and a gasholder some 30 or 40 yards away. Three Diesel-engine sets, with an aggregate capacity of about 500 kW, were destroyed, and as a result, the town has been deprived of electricity and cannot look forward to any resumption of the service for a long time. The cost of the damage is estimated at £150,000.



THE DESTROYED CLACTON STATION.

A Large Relay Automatic Private Branch Exchange.—The Relay Automatic Telephone Company has manufactured and installed on behalf of the General Post Office, in Messrs. Debenhams' building, 17, Wigmore Street, a private branch automatic telephone exchange of the latest type, which effects its connections in four seconds and gives a continuous day and night service of internal communication together with public exchange facilities on a rental basis. This switchboard has an initial equipment of 400 lines, with an ultimate capacity of 1,270.

The new apparatus is located in the old switchroom, which is an hexagonal chamber at the base of the tower on the roof. The installation has four manual positions, each fitted with 15 cord circuits and positive lamp supervision.

The board is provided with two 32-volt batteries of 244 ampere-hours capacity, a charging generator, and two battery-driven ringing dynamotors. There are 40 outgoing public exchange lines and 25 incoming, while facilities are provided for extending the exchange lines to 10 automatic extensions at night. Owing to the limited space, only 320 lines could be fitted until such time as the old manual switchboard had been removed.

During the first week of service, the automatic calls averaged over 3,000 per day; the automatic calls to the exchange (about 1,200) and the incoming calls from the exchange kept four operators fully employed.

The new switchboard was cut over at 2 p.m. on December 8th by inserting plugs in the break jacks of the old manual board and then removing insulating plugs at the new main distribution frame, a matter of a few minutes' work. During Saturday afternoon, December 8th, and Sunday, December 9th, the plant and instruments were thoroughly tested out, and on Sunday the old manual board was disconnected and removed in preparation for the completion of the initial equipment.

When the exchange at Debenhams' is completely installed it will be a great deal larger than any p.a.b.x. installation at present existing in the British Empire.

The Development of the St. Lawrence.—The Toronto correspondent of *The Times* states that a serious political issue is developing over the international waterways project. Included in this is the scheme which was put forward in 1921 by the Joint International Commission for the deepening of the St. Lawrence waterway for the purposes of navigation and water power. The scheme, if carried out, would permit ocean-going ships to reach the Great Lakes, while water power, estimated at 4,000,000 h.p., would be made available for development. The cost of the project has been estimated at from £50,000,000 to £100,000,000. Owing to the division of opinion in Canada, the Dominion Government is inclined to delay negotiations with the United States. Montreal and Quebec are generally hostile to the project, the Atlantic Provinces hostile or indifferent, while Ontario and the Western Prairie Provinces are in favour of the early construction of the waterway.

New Swedish Electric Furnace.—The well-known engineer, M. Cornelius, has invented a new type of furnace, called the electro-thermic accumulator furnace, by means of which it is possible to control the heating of metals, especially iron and steel, to any degree desired up to 1,300 degrees Celsius. The invention has also solved the problem of the electrical manufacture of uncoloured window glass. A six weeks' trial made with the furnace at the Stridsberg & Bjoerk workshops at Trollhaettan is said to have yielded extremely good results. —*Reuter's Trade Service* (Stockholm).

Some Pip!—The following letter has been received by the Siemens & English Electric Lamp Co., Ltd., from an official of a large electric tramway company:—

A LIGHT THAT DID NOT FAIL.

"I am sending you this lamp, which I think you will be pleased to see. As a test of strength, both glass and drawn wire, I think this lamp has proved well, seeing that over four months ago it was put into one of our traffic offices, and two days after received a hit on the pip with a pair of steps, which knocked it into this shape, and it has burnt ever since, and still will."

Post Office Tube.—There is every prospect that the tube railway between Paddington and Whitechapel for the carrying of mails will be in operation in the near future. The completion of the work has been delayed owing to the high prices quoted in tenders sought soon after the war, but it has now been decided to proceed with the station work, the laying of the permanent way, and the electrical equipment. Intermediate stations have been provided at the Western Parcels office, Western District office, Western Central District office, Mount Pleasant, and King Edward Building, Newgate Street. The running tunnels are of 9 ft. internal diameter and have two separate lines of tracks, with a gauge of 2 ft., one for west-bound and one for east-bound traffic. Steel motor wagons, which may be used either singly or in trains of two or three wagons, each carrying a load of 10 cwt., will be operated by automatic means, control being exercised by a switchboard in each station. There will be no drivers on the wagons or trains. A complete installation of lifts, conveyors, elevators, and chutes will be provided for the handling of mails. The opening of the line will relieve the streets of a considerable tonnage of mail traffic, and assist in the solution of the London traffic problem. The original complete scheme of the railway provided, in addition to the main route, for branch lines to link the tube with Euston, King's Cross, and other railway termini.—*The Times*.

Fishing by Electric Light.—Arbroath fishermen, having installed electric light on some of the larger boats, are now able to work much longer at the fishing grounds. The installation consists of a dynamo driven from the flywheel of the engine which generates current to supply light and simultaneously charge a storage battery.

Fatality.—A Greenock caulker was killed recently while working at the overhaul of a steamer. Electric light, it is stated, was supplied to the bottom of the dock, where the man was employed, from a temporary switchboard on the deck of the vessel. The man took hold of a cluster of lamps by the reflector in order to move it into position, and he was killed instantaneously.

Diffused Colour Lighting.—On January 8th, at their Elverton Street, S.W., showrooms, Messrs. Holophane, Ltd., demonstrated a system of diffused colour lighting applicable to the auditoria and to the screens of kinemas. The regulations of the L.C.C. governing the conduct of theatres require that there shall be at all times a minimum of light. The use of "white" light for this purpose is not practicable in kinemas, and lamps provided with screens of a single colour are rather crude. By means of an exquisitely tinted lamp within a "Holophane" prismatic dome or pendant-type fitting, the Holophane company provides a soft polychromatic illumination of low intensity, but with sufficient distribution to meet the need for light during the exhibition of a film. To vary the programme, and at the same time to rest the eyes of the audience, a scheme for illuminating a screen in a variety of tints and shades has been evolved. The system involves the use of a delicately-coloured screen which is made to travel by a screw gear across the projector. This was demonstrated by means of a screen bearing an Egyptian desert scene, which was made with a certain amount of verisimilitude to pass through the changing lights of day—morning, noon, and night.

The methods would appear to offer to kinema proprietors a chance to improve their interior lighting, and the system might also be used to advantage in many shop windows.

Peru and Politics.—Political uncertainty appears still to hamper the progress of Peru. In his recent report on that country's trade, Mr. A. J. Hill, British Vice-Consul at Callao, was unable to describe the outlook as particularly bright. A number of rich families, he says, have been obliged, for political reasons, to remain outside the country, and this withdrawal of spending power has had its effect upon business. For various reasons importers appear to have been overbuying, and some orders which had been "rushed" in anticipation of a new Customs tariff were cancelled, when the new duties were applied, at only a few days' notice. The Consul says that unfortunately the practice of rejecting goods is not uncommon among the smaller importers in Peru, whenever the market goes against them. At present, he adds, stocks in most lines are large.

The report comments upon German competition in machinery, hardware, electrical appliances, &c., and that of the United States in similar lines. It adds that British goods are well established, hold the best reputation, and are easily preferred, provided the price is favourable.

Merchants and consignees in England could, it is said, greatly assist British shipping, which is meeting with increasingly keen foreign competition on the Western coast of South America, by adopting the system, said to have been effective in the case of German and American shipping, of informing their clients and shippers that they would prefer to see their goods coming to England in British bottoms.

Mr. Hill refers to the fact that the "Dunsmuir" concession, which has excited much interest during the last year or two, has now lapsed, Mr. Dunsmuir, after depositing £p.20,000, having failed to produce the stipulated sum of £p.1,245,000 before the date fixed, August 2nd, 1923. Other financial interests are in the field for this contract, but, he adds, if undertaken by any of them, it will probably in a very much modified form.

With regard to the supply of electric power in Lima, the Consul reports that the Electricity Company, controlling the lighting, tramways, &c., of the capital and surrounding district, has been taken over by the Impresa Elettriche dell' America Latina (Latina Lux), of Milan, for the purpose of improving the supply and renewing the plant. The work will take not less than three years. The original contract with the municipality for the exploitation of these services has now been modified by the Government to allow of the increase of charges, &c., and permits, for a period of five years from October, 1922, the importation of materials free of duty.

Electricity Supply at Birmingham.—The increasing demand which has been experienced of late has led the Electricity Committee to submit to the City Council proposals for important extensions of generating plant, which were to be considered at a meeting on Tuesday last. It is proposed to displace small sets at Summer Lane having an aggregate output of 24,000 kW, substituting two 20,000-kW turbo-alternators, at a cost of £104,000. Other proposals are to install two 1,500-kW d.c. turbo-generators at the Nechells works to supply power for the auxiliary plant, at a cost of £36,000; and to add to the number of sub-stations at a cost of £61,500. The total outlay on new plant and buildings will thus amount to £201,500.

It is proposed also to make the supply voltage in the Aston and Handsworth areas uniform with the rest of the Birmingham area; the first two districts have been supplied at 230/460 and 240/480 volts respectively since their incorporation with the city in 1911, whilst the city voltage is 220/440 volts. This change is estimated to cost £8,400.

Steel Conduits and Fittings.—The British Engineering Standards Association has issued a new revision of the Standard Specification for Steel Conduits for Electric Wiring (B.S. Specification No. 31). The following modifications have been made to the original standards, which, it is interesting to note, had been almost universally adopted:—Two additional diameters have been included, namely, ¾ in. and 2½ in. In the case of conduit having a larger diameter than 1 in., the screw threads have been slightly shortened. In other respects the specifications for the conduits remain the same, but a comprehensive range of standards for the fittings used with conduits has been included, together with tests to be applied to the materials used in the manufacture of both the conduit and the fittings. The use of this specification will ensure the supply of a good practical quality of steel conduit and fittings. About three years ago the Government Departments decided to co-ordinate their own specifications for electrical apparatus so as to make use as far as possible of ordinary good class commercial articles, and for this purpose set up a committee, which decided to adopt the British Standard Specification No. 31, and recommended its extension to include a 2½-in. tube, with a further addition of detailed standards for fittings. The B.E.S.A. Committee brought together all the British makers of conduits, and after considerable discussion, general agreement was reached. This specification, therefore, will set a standard for the makers, the Government Departments, and for all purchasers of good quality conduit, and the more British Standard conduit and fittings are demanded, the better for the electrical industry and the public. Copies of this publication may be obtained from the B.E.S.A. Publications Dept., 28, Victoria Street, S.W.1. Price 1s. 2d. post free.

Institution Notes.

Institution of Electrical Engineers.—The first meeting of the second half of the 1923-1924 session was held on Thursday last, when Dr. S. Parker Smith delivered his lecture on "Railway Electrification in Foreign Countries." The official list of other fixtures for the session is as under:—

January 10th.—Continuation of discussion on A. Bachellery's paper on "The Electrification of the Midi Railway." [Joint meeting with the Société des Ingenieurs Civils de France (British Section.)]
January 17th.—H. Marryat. "Electric Passenger Lifts."
January 31st.—Prof. W. M. Thornton, O.B.E., D.Sc. "Some Researches on the Safe Use of Electricity in Coal Mines."
February 14th.—Continuation of discussion on "Loud-Speakers for Wireless and other Purposes." (Joint meeting with the Physical Society of London.)
February 21st.—Annual dinner. At the Hotel Cecil (7 for 7.30 p.m.).
February 28th.—A. S. FitzGerald. "The Design of Apparatus for the Protection of Alternating-Current Circuits."
March 6th, March 13th, March 27th, April 10th.—Subjects to be announced later.
April 24th. G. Semenza. The Fifteenth Kelvin Lecture.
May 8th.—Annual general meeting.

WIRELESS SECTION MEETINGS.

February 6th.—E. B. Moullin, M.A. "Atmospherics and their effect on Wireless Receivers."
March 5th.—Commander J. A. Slee, C.B.E., R.N. "The Development of Direction-finding in the Mercantile Marine of Great Britain."
April 2nd.—Research staff of the General Electric Co., Ltd. "Thermionic Valves with Dull-emitting Filaments." (Work conducted by M. Thompson and A. C. Bartlett.)
May 7th.—Subject to be announced later.

INFORMAL MEETINGS.

January 21st.—Discussion on "Broadcasting." (To be opened by Mr. E. H. Shaughnessy, O.B.E.)
February 4th.—Discussion on "Storage Battery Troubles." (Mr. F. W. Crawter.)
February 18th.—Discussion on "Electrical Development in France." (Mr. E. M. Malek.)
February 25th.—Smoking concert at the Engineers' Club, Coventry Street, W.1.
March 3rd.—Discussion on "The Selection and Location of Converting Plant for Supplying d.c. Networks." (Mr. R. D. Spurr.)
March 17th.—Discussion on "Illuminating Engineering, its Application and Value to the Electrical Industry." (Messrs. L. Gaster and J. S. Dow.)
March 31st.—Discussion on "Economics in Engineering." (Mr. F. Gill, O.B.E.)
April 14th.—Discussion to be opened by Mr. J. R. Bedford. (Subject to be announced later.)

Institution of Heating and Ventilating Engineers.—A paper was read by Mr. Thomas Lindsay at a meeting of the Institution on January 9th, in which he described the Arca automatic regulator and its application to the automatic control of high or low pressures in steam or liquids, pressure or vacuum in gases, the production of gas in gas producer plants, the control of load on electric motors, &c. The apparatus was described in the ELECTRICAL REVIEW of August 3rd, 1923.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. A. H. DARKER, A.M.I.Mech.E., A.M.I.E.E., chief electrical engineer of Messrs. J. Stone & Co., Ltd., Deptford, London, S.E., is sailing from England on Friday, January 18th, for an extended business trip around the world.

Mr. E P BENNETT is leaving on February 3rd, per s.s. *Orsova*, for Australia, after which he will proceed to New Zealand, and return home *via* South Africa, in the interests of Messrs. Cargills, Ltd., Balfour House, London, E.C., export merchants and shippers. Mr. Bennett completed a world tour in May of last year.

Mr. F. W. **Baidons**, organiser of the Shipping, Engineering and Machinery Exhibition, has left for a three months' visit to South Africa in connection with the exhibition to be held at Olympia in 1925.

Mr. J. N. STEPHENS, manager of the wiring supplies department of the British Thomson-Houston Co., Ltd., has left on a two to three months' trip to the United States to study the latest practice in electric lighting.

As from December 31st last Mr. E. C. WANSBROUGH has resigned his position with the London Electric Wire and Smiths, Ltd., to take up another appointment shortly. Meanwhile communications should be addressed to 3, Victoria Street, S.W.1.

Consequent on the resignation of Mr. F. E. Hughes (secretary) and Mr. J. A. Cookson (sales manager and mains surveyor) under the superannuation scheme, Manchester Corporation Electricity Commitee has made the following appointments, subject to the approval of the Establishment Committee, and confirmation by the City Council:—Financial controller, Mr. W. E. Foden, who, in addition to his present duties, will, from January 1st, take control of the rental office, basic salary as from January 1st, 1924, £900, plus Civil Service bonus, the basic salary as from January 1st, 1925, to be £1,000. Management secretary, Mr. F. T. Guildford, basic salary £500 plus bonus. Committee secretary, Mr. C. Cradock, basic salary £400 plus bonus. Fuel clerk, Mr. W. A. Howard. Sales manager and mains surveyor, Mr. C. H. Rayner, basic salary £500 plus bonus. Assistant sales manager, Mr. G. A. Proctor. Assistant mains surveyor, Mr. P. M. Barber. Showrooms manager, Mr. P. Howard. Certain other members of the staff in the sales manager's section have been re-graded, in consequence of a re-arrangement of duties.

Manchester Corporation Tramways Committee recommends the following rearrangements of staff owing to the resignation of Mr. James Wood from the post of assistant manager and financial superintendent, which took effect at the end of 1923, and the death of Mr. J. J. M'Mahon, electrical engineer:—Mr. Henry Mattinson, general manager and chief engineer, salary £1,700, rising to £2,000 by annual increments of £100. Mr. F. A. Mitcheson, financial controller, salary £850 without bonus, rising to £1,000 by annual increments of £50. Mr. W. S. Belshaw, chief cashier, salary £450, with present bonus £145, rising to £500 by annual increments of £25. Mr. C. H. Pepper, assistant accountant, to perform increased duties, salary £450, plus present bonus of £145. Mr. W. Grey, secretary, to perform increased duties, salary £475, plus present bonus, £157. Mr. G. R. Blackburn, electrical and rolling stock engineer, salary £900, without bonus, rising to £1,000 by two annual increments of £25 and one of £50. Mr. C. H. Grindrod, assistant electrical engineer at £400, with present bonus £124.

The *Daily Telegraph* states that Mr. W. MCLENNAN CITRINE, assistant general secretary of the Electrical Trades Union, at its headquarters at Manchester, has been appointed assistant secretary of the Trade Union Congress in succession to Mr. Fred Bramley, who was recently appointed general secretary.

Mr. GRANT M'LENNAN, who has been with Scottish Oils, Ltd., for over two years, has been appointed chief electrical engineer to the company.

A silver loving cup (a token of esteem from the employés at the Worcester electricity station) was presented on January 3rd to Ald. W. J. HILL, the former chairman of the Worcester Electricity Committee. Mr. C. M. Shaw, the city electrical engineer, presided and made the presentation. There was a full attendance, and the company included Mr. P. J. Roberts, the new chairman of the committee. The gift was organised by the Works Recreation Committee, of which Mr. Shaw is chairman and Mr. L. S. Everitt secretary. Ald. Hill, in accepting the gift, said it was a matter for satisfaction that Worcester, in view of the recent legislative changes, had preserved its existence as a generating station. Mr. Shaw had been a tower of strength to the undertaking.

Mr. R. DEAN, of Keighley, has been appointed distribution assistant to the Kettering Urban District Council electricity department.

Owing to illness, Professor G. W. O. HOWE, D.Sc., M.I.E.E., was unable to deliver the lecture on "World-wide Radio Telegraphy," announced to be given under the auspices of the Scottish Centre of the Institution of Electrical Engineers, in Edinburgh, on January 8th.

Obituary.—THOMAS MOODIE; JOHN EDMUND WILSON; and CHARLES WILLIAM DONALDSON.—We regret to learn that as a result of the turbine explosion which occurred at the Shanghai electricity works on November 15th, three British engineers were killed. The *North China Herald* for November 17th gives particulars from which we learn that they were Thomas Moodie, charge engineer; John Edmund Wilson, switchgear superintendent; and Charles William Donaldson, representative of Messrs. C. A. Parsons & Co., who went out from England to erect the plant. Mr. Moodie was a Scottish engineer, aged 32 years. He served his apprenticeship with the Clyde Shipbuilding and Engineering Co., and in April, 1923, he joined the Shanghai electricity department as a charge engineer. Mr. J. E. Wilson was well known to the Shanghai engineering community. He was born at Maryport, Cumberland. He was a keen sportsman, with special skill at golf and billiards, and his loss is seriously deplored at the electricity works and keenly felt by members of the Marine Engineers' Institute Club. He was considered to have a promising engineering career in front of him, and was one whom it will be difficult to replace at the works. Mr. C. W. Donaldson had only arrived at Shanghai last autumn. He was sent out by Messrs. Parsons to erect the complete plant, and was in charge of the machine at the time of the accident, as the electricity department had not at the time taken over the machine from the contractors. We wish to express our sympathy with the relatives of the three gentlemen who have lost their lives, as well as with Mr. Whitelock, a member of the staff who was seriously injured in the accident, and had to have a leg amputated.

MR. W. H. BENNETT.—The death took place on January 1st of Mr. William Henry Bennett, consumers' engineer at the Southampton Corporation electricity department.

New Companies Registered.

Craftsman Lamp Co., Ltd. (194,842).—Private company. Registered January 3rd. Capital, £10,500 in 10,000 preference shares of £1 and 10,000 ordinary shares of 1s. each. To develop inventions relating to improvements in projection lamps for use as head lamps for motor-cars and other purposes, and to carry on the business of manufacturers of and dealers in all appliances for the production of lighting equipments, and lamps, reflectors, lampholders, incandescent electric lamp bulbs, dynamos, accumulators, &c. The first directors are:—H. Workman, Chad Hill, Edgbaston, Birmingham; G. Bostock, 21, Ironmonger Lane, E.C.; R. McNair, "St. Helens," Westwood Park, Forest Hill, S.E. Qualification, £100. Remuneration as fixed by the company.

Wavelengths, Ltd. (194,837).—Private company. Registered January 2nd. Capital, £250 in 1s. shares. To carry on the business of wireless material and accessories manufacturers, merchants, agents, importers and exporters, &c. The permanent directors are:—H. A. Gottlieb, 1, Fitzroy Road, Regent's Park, N.W.1; H. Levy, 48, Inverness Terrace, W.2. Qualification of permanent directors, 20 shares. Registered office: 4, Edmund Place, Aldersgate Street, E.C.1.

Honeywoods, Ltd. (194,679).—Private company. Registered December 24th. Capital, £300 in £1 shares. To adopt an agreement with J. H. Honeywood for his services and experience in the manufacture and sale of wireless sets, &c., to carry on the business of electrical, mechanical and motor engineers, manufacturers of and dealers in appliances and accessories used in connection with the distribution, supply, accumulation and storage of electricity. The permanent directors are:—S. K. Davies, Westgate Hotel, Newport, Mon.; D. Ross, 26, Fields Road, Newport, Mon.; J. Moxon, 4 and 5, Commercial Street, Newport, Mon. Qualification, £25 shares. Solicitor: J. Moxon, 5, Commercial Street, Newport, Mon.

W. Diskett, Ltd. (194,742).—Private company. Registered December 28th. Capital, £250 in £1 shares. To carry on the business of manufacturers and importers of and wholesale and retail dealers in wireless apparatus, &c. The permanent directors are:—A. J. Elliott, 20, Glenthorn Road, West Jesmond, Newcastle-on-Tyne; T. G. Elliott, 44, Glenthorn Road, West Jesmond, Newcastle-on-Tyne; W. H. Diskett, 50, Falconer Street, Newcastle-on-Tyne. Qualification, £25 shares. Remuneration, £5 each per annum. Secretary: W. H. Diskett. Registered office: 39, Emerson Chambers, Blackett Street, Newcastle-on-Tyne.

New Radnor Electric, Ltd. (194,683).—Private company. Registered December 24th. Capital, £650 in £1 shares. To carry on the business of an electric light company in all its branches. The provisional directors are:—J. Langston, Maes-yfeal, New Radnor, Radnorshire, consulting engineer; J. H. Langston, 16, Bridge Street, Kington, Herefordshire, electrical engineer. Qualification, one share. Solicitors: J. R. Swindells, Kington, Herefordshire.

J. B. Meiklejohn, Ltd. (12,950).—Private company. Registered December 27th in Edinburgh. Capital, £10,000 in £1 shares. To carry on the business of electricians, electrical, hydraulic, consulting and civil engineers, architects, designers, &c. The first directors are:—J. B. Meiklejohn, Hillhouse, Uddington, electrical engineer; A. S. Hutcheon, 18, Garturk Street, Glasgow, cashier; G. E. Osborne, 18, Broompark Drive, Dennistown, Glasgow, draughtsman; J. Douglas, 6, Battlefield Avenue, Langside, Glasgow, book-keeper. Qualification, 100 shares. Registered office: 115, Bath Street, Glasgow.

Official Returns of Electrical Companies.

Holsworthy Gas and Electric Supply Co., Ltd.—Particulars filed of £2,000 "C" debentures authorised December 20th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, subject to the mortgages and debentures ranking in priority thereto, the whole amount being now issued.

English Electric Co., Ltd.—Conveyance dated December 18th, 1923 (supplemental to trust deed dated September 15th, 1919, securing £1,000,000 5½ per cent. sinking fund first mortgage debentures) charged on various properties in Preston, certain rights and liabilities, &c. Trustees: Debenture Corporation, Ltd., Worcester House, Walbrook, E.C.4.

Kelley and Tarshis, Ltd.—Debenture dated December 12th, 1923, to secure £700, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: A. Gould, 45, Fountayne Road, N.16.

Orlings Telegraph Instruments Syndicate, Ltd.—Particulars filed on December 20th, 1923, of £2,500 debentures authorised January 9th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £300 (on December 19th, 1923).

Lawless, McLintock, Lawson & Co., Ltd.—E. Lowndes, of 17, Garden View, Sale, Manchester, ceased to act as receiver or manager on November 30th, 1923.

Skegness Electricity Supply Co., Ltd.—Issue on December 19th, 1923, of £100 debentures, part of a series already registered.

Holmes and James, Ltd.—Mortgage dated November 21st, 1923, to secure certain moneys paid for wages and other preferential claims, charged on certain book debts. Holder: A. W. Boston, 38, Handsworth Wood Road, Birmingham.

Coates & Co. (Sheffield), Ltd.—Issue on December 19th, 1923, of £2,000 debentures, part of a series already registered.

Trust Electrical Accessories Manufacturing Co., Ltd.—Debenture dated December 27th, 1923, to secure £370 7s. 6d., charged on the company's property, present and future, including uncalled capital. Holder: Mrs. A. Berg, 196, Green Lanes, Stoke Newington, N.16.

Wireless Experts, Ltd.—Debenture dated December 10th, 1923, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Lieut.-Col. G. R. P. Wheatley, Burnside, Storrington, Surrey.

Warwickshire and South Midland Electricity Supply Corporation, Ltd.—Particulars filed of £12,000 debentures and a premium of 7 per cent. authorised by resolutions of December 21st and 24th, 1923, charged on the company's property, present and future, including uncalled capital, the whole amount being now issued.

British Illuminated Sign Co. (1923), Ltd.—Charge on the company's undertaking and property, present and future, including uncalled capital dated December 6th and collateral mortgage by demise, secured upon 1, Bosworth Road, Kensal Road, W.10, dated December 20th, 1923, to secure £500. Holder: R. G. Bradshaw, 42, Harley Street, W.

Midland Counties Electric Supply Co., Ltd.—Satisfaction (a) to the extent of £398,500 on December 27th, 1923, of trust deed dated December 14th, 1921, securing £400,000 7½ per cent. debenture stock; and (b) in full on June 30th, 1922, of trust deed dated February 14th, 1921, securing £375,000 8 per cent. secured notes, of which £200,000 was issued. (Notices filed December 29th, 1923.)

Lowth & Smith, Ltd.—T. Forster, of 28, Deansgate, Manchester, ceased to act as receiver and manager on December 21st, 1923.

C. F. Casella & Co., Ltd. (106,869).—Return dated December 16th, 1923. Capital, £17,000 in 15,000 ordinary and 2,000 preference shares of £1 each. 12,204 ordinary and 2,000 preference shares taken up. £3,504 paid. £10,700 considered as paid. Mortgages and charges, £1,800.

Europe & Azores Telegraph Co., Ltd. (39,452C).—Return dated July 11th, 1923. Capital, £300,000 in £10 shares. All shares taken up. £144,320 paid. £55,080 considered as paid. Mortgages and charges, nil.

City Notes.

Clyde Valley Electrical Power Co.—According to the *Financial Times*, the directors have applied for the grant of a Provisional Order empowering them to raise additional capital. The authorised capital is £1,900,000, but the company has already expended £2,363,000 on capital account in connection with its undertaking. The Order therefore proposes to authorise the creation of £1,000,000 additional ordinary or preference capital, with the right to raise on this capital a further £500,000 by the creation of debenture stock. The company also asks to be empowered to sub-divide its present issued capital of 140,000 £10 ordinary and preference shares into shares of £1 each.

Anglo-American Telegraph Co., Ltd.—Balance dividend of ½ per cent. on the ordinary consolidated stock, making 3½ per cent. for 1923. Balance dividend of 1½ per cent. on the preferred stock, making 6 per cent. for 1923, and a first and final dividend of 1½ per cent. on the deferred stock.

Stock Exchange Notices.—The undermentioned have been ordered to be officially quoted:—

City and South London Railway Co.—Scrip, fully and partly paid, for £3,796,000 4½ per cent. redeemable second debenture stock, 1942-1972 (guaranteed by the Imperial Government).

Eastern Extension, Australasia and China Telegraph Co., Ltd.—7,206 shares £10 each, fully paid (Nos. 390,630 to 397,835).

London Electric Railway Co., Ltd.—Scrip, fully and partly paid, for £2,356,000 4½ per cent. redeemable second debenture stock, 1942-1972 (guaranteed by the Imperial Government).

Tata Power Co., Ltd.—Scrip, fully and partly paid, for £1,000,000 4½ per cent. guaranteed "A" mortgage debenture stock, 1929-1948 (guaranteed by the Imperial Government).

Urban Electric Supply Co.—£100,000 five and a-half per cent. mortgage debenture stock.

Crompton & Co., Ltd.—Interim dividend at the rate of 5 per cent. per annum on the preference shares for the six months ended September 30th, 1923.

Canadian General Electric Co., Ltd.—The *Financial News* states that the offer of the General Electric Co., of New York, of $62.50 cash New York funds and one fully-paid $50 share of new 7 per cent. cumulative preference stock of Canadian General Electric Co. for each $100 share of the present common stock has been accepted by shareholders representing over 85 per cent. of the stock to which it was applicable. The proposed transaction will therefore be carried through to completion.

Stocks and Shares.

MONDAY EVENING.

THERE is an uncomfortable feeling prevalent in most of the markets of the Stock Exchange. The New Year entered without bringing its usual complement of orders from people wanting to reinvest dividends, and willing to free the money which they had been keeping in the banks for the purpose of window-dressing. The opening of Parliament this week is advanced as the reason why capitalists, small and large alike, prefer to do nothing until they see in which direction the political cat is likely to jump. Inasmuch as there will be nothing definite done in Parliament until next week, uncertainty will charge the air for, it may be, the greater part of this month. The consequence is that prices show a tendency to droop, and the Stock Exchange man finds his time occupied with the transaction of so very moderate an amount of business that he has some justification for the complaint of being out of work.

Various prospectuses have reached us of the Warwickshire and South Midland Electricity Supply Corporation, Ltd. In this company £12,000 7 per cent. guaranteed first mortgage debentures are being offered at 98 per cent. and 12,000 8 per cent. cumulative preference shares at par. They are offered by the Barford Electric Supply Co., Ltd. The particulars which are given of the Warwickshire concern cannot be called convincing to the man who looks for security for his money, and those who are invited to subscribe may be recommended to put safety first and to utilise their money in the purchase of something that offers greater security. Obviously, from the merely market point of view, it is possible to assume that there may be any ready negotiation in debentures and preference shares of so small a number.

The Home Railway market is in a curious condition, torn on the one hand by fears of Labour legislation, while on the other the dividend outlook is regarded as being hopeful—not to say promising. The effect of these considerations is to leave prices without a great deal of change on the week, though the tendency, in the absence of business, drifts slightly downwards. The alterations, however, are slight, and Underground Incomes, on the fall in sterling as compared with the dollar, are 1 up.

In the group for British Traction issues, the continued flatness of London and Suburban preference shares, coming so close to the time when the dividend announcement falls due, is regarded with uneasiness; holders of the shares are getting justifiably nervous with regard to the likelihood of a dividend being declared. No announcement has been made, but the fact of these £1 shares standing at 6s. 3d. can only be regarded as significant. British Electric Traction issues are quiet. It is said that important developments are contemplated with regard to the Yorkshire Electric Company, and curiosity runs expectantly upon the lines that may be adopted in the future by this enterprising concern.

The Anglo-Argentine Tramways group weakened, by reason of the statement that the department of the Argentine legislature charged with settlement of the questions at issue between the company and the municipality of Buenos Ayres has adjourned until March, no decision having been reached on the various points outstanding between the two bodies. This postponement is disappointing in that it puts off, for many weeks to come, the chance of the debatable points becoming settled. British Columbia stocks are higher, as a result of the increased dividends, but in Mexicans there is neither animation nor strength. Brazilian Tractions proved an exception to the generally dull rule, the price putting on a point because of the improvement in the milreis.

There has been rather more animation in the market for electricity supply shares. Prices went down rather sharply towards the end of last year, on the apprehensions of nationalisation and capital levy. The falls, however, attracted purchasers, and the weakness is gradually being wiped out by the steady absorption of floating shares. Changes on the week are unimportant.

Edmundson's preference and City of London preference are both easier. Newcastle-on-Tyne Ordinary rose to 16s. 3d., but, in the same provincial list, the new Bournemouth and Poole ordinary, which touched 3s. 6d. premium soon after the issue was made, have sagged to 1s. premium. Amongst the manufacturing shares, Edisons are unchanged at 4s. 6d. x.d. Siemens at 16s. 3d. are 1s. 3d. harder. General Electric preference eased off to 22s. Babcock and Wilcox remain at 2¼.

The cable group has been distinctly weak, and falls are left on balance, in spite of the fact that the drop tempted a little buying, which raised prices from their lowest. Western Telegraphs are the heaviest in this department, a fall of 7s. 6d. reducing the price to 15½, the shares having been particularly dull since the issue of the recent report. Eastern Extensions are 5s. lower at 16¾; the Globes gave way similarly to 16¾. Eastern ordinary shows a loss of 1¼. On the other hand, Cuba Submarines are better at 7¼. The American stocks show no change. The project for installing another important cable under the auspices of British, Italian, and American interests arouses a good deal of attention, and is regarded by believers in cable securities as another, and very effective reply, to the jeremiads of those who claim that the cable will shortly be superseded by wireless. Marconis are a dull market, in sympathy with the heaviness prevailing in most parts of the Stock Exchange.

Nothing fresh of interest has occurred in rubber shares, and the iron and steel group is distinguished only by falls that occur, limited as a rule to a few pence, day by day in the shares of the leading companies. In short, Stock Exchange business is in a state of suspended animation, nor is it likely that there will be any semblance of vitality until the House of Commons gets to grips on matters of vital consequence in the early part of next week.

Share List of Electrical Companies.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price Jan. 7, 1923.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.						
Brompton Ordinary	£ 1	12	12	20/6	−1/9	£5 1 6
Charing Cross Ordinary	5	9	14½	14½	+ ½	4 16 7
do. do. do. 4½ Pref.	5	4½	4½	4⅝	—	5 9 1
Chelsea	1	6	10	9⅞/-	—	5 11 1
City of London	1	14	15	2⅛	—	6 9 10
do. do. 6 % Pref. ...	1	6	6	22/-	−1/-	5 9 1
County of London	1	8	10	40/6	+6d.	4 18 9
do. do. 6 % Pref. ...	1	6	6	22/-	−1/-	5 9 1
Edmundson's Ordinary	3	Nil	7	4	—	5 6 1
do. 6 % Pref	5	12/-	6	5½	− ½	5 14 3
Kensington Ordinary	5	10	12	10⅜	—	5 15 6
London Electric	3	4	10	4½	—	6 6 0
do. do. 6 % Pref. ...	5	6	6	5½	—	5 9 1
Metropolitan	1	7	8½	33/9	—	5 0 9
do. 4½ % Pref.	1	4½	4½	17/6xd	—	5 2 10
Newcastle-on-Tyne Ordinary ...	1	Nil	3½	16/3	+9d.	3 1 6
do. 5 % Pref. ...	1	5	5	15/6	—	6 9 0
do. 7 % Pref. ...	1	7	7	22/-	—	6 1 9
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	22/-	—	5 9 1
Urban Ordinary	1	Nil	—	18/9	—	Nil
do. 6 % Pref. ...	1	2½	5	18/9	—	6 9 4
St. James' and Pall Mall ...	5	13	14½	11⅜	—	6 4 9
South London	1	7	10	1 1/2	—	5 8 3
South Metropolitan Pref. ...	1	7	7	24/6	—	5 14 8
Westminster Ordinary	5	10	12	10⅞	—	5 19 5
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	19/9	—	7 8 2
HOME RAILS.						
Central London Ord. Assented	Stock	4	4	7⅜	—	5 9 7
Metropolitan	,,	2½	3½	7⅜	—	4 17 3
do. District	,,	1	3	54	− ½	5 11 2
Underground Electric Ordinary	10	Nil	Nil	2½	—	Nil
do. do. "A" ...	1	Nil	Nil	8/-	—	Nil
do. do. Income	Bonds	4	5	101	+1	*5 18 10
TELEGRAPHS AND TELEPHONES.						
Anglo-Am. Tel. Pref.	Stock	6	6	109½	—	5 15 11
do. Def.	,,	1½	34/6	22½	—	6 9 0
Chile Telephone	5	6	6	6	—	5 0 0
Cuba Sub. Ord.	10	7	7	7½	+ ½	9 13 2
Eastern Extension	10	10	10	16⅜	− ½	6 2 2
Eastern Tel. Ord.	Stock	10	10	162½	−1½	6 3 1
Globe Tel. and T. Ord.	10	10	10	16½	− ½	5 19 5
do. do. Pref.	10	6	6	11½	+ ½	5 7 10
Great Northern Tel.	10	24	22	28	—	7 17 2
Indo-European	25	10	7	22½	—	*5 7 8
Marconi	1	25	15	2⅛	—	7 5 6
Oriental Telephone Ord. ...	1	12	12	1⅝	—	*6 8 0
United R. Plate Tel.	5	8	8	6⅜	− ½	*5 18 4
West India and Panama ...	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	15½	− ½	*6 9 0
HOME AND FOREIGN TRAMS, &c.						
Anglo-Arg. Trams. First Pref.	5	5½	12½	8	− ⅛	9 1 6
do. do. 2nd Pref.	5	Nil	5½	2½	—	9 15 6
do. do. 5% Deb.	Stock	5	5	75½	−2½	6 12 5
British Electric Traction Ord.	,,	4½	5	67	—	7 9 3
do. do. 6% Pref.	,,	6	6	98½	—	6 1 10
Brazil Traction	100	Nil	4	48	+1	8 6 8
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	85½	+1	5 17 0
do. do. Preferred	,,	5	96/-	86½	+1½	*5 12 6
do. do. Deferred	,,	5	127/-	100	+1½	*6 9 5
do. do. Deb. ...	,,	4½	4½	78½	—	5 8 3
Lond. & Sub. Trac. 5 % Pref.	1	5½	5	6/6	—	15 7 8
London United Tram. Deb. ...	Stock	4	4	67½	—	5 19 2
Mexico Trams. 5 % Bonds ...	—	Nil	Nil	69½	—	7 4 0
do. 6 % Bonds ...	—	Nil	Nil	80½	—	Nil
Mexican Light Common ...	100	Nil	Nil	18	—	Nil
do. Pref.	100	Nil	Nil	44½	− 3	Nil
do. 1st Bonds ...	—	Nil	5	59½	−1	8 8 0
MANUFACTURING COMPANIES.						
Babcock & Wilcox	1	15	20	2⅛	—	*4 8 11
British Aluminium Ord. ...	1	10	5	18/9	—	5 6 8
British Insulated Ord.	1	15	15	2⅛	—	6 0 0
Callenders	1	15	15	2⅛	—	6 6 4
do. 6½ Pref.	1	6½	6½	24/3	—	5 7 2
Crompton Ord.	1	10	5	¾	—	10 0*0
Edison-Swan	4/-	10	Nil	4/6	—	Nil
do. do. 5% Deb. ...	Stock	5	5	66½	—	7 10 5
Electric Construction	1	10	10	29/6	—	6 15 7
English Electric	1	5	5	17/-	—	5 17 8
do. do. Pref.	1	6	6	19/6	—	6 3 1
Gen. Elec. Pref.	1	6½	6½	22/-	−6d.	5 18 2
do. Ord.	1	10	5	19/9	—	5 1 3
Henley	1	15	15	48/3	−6d.	6 4 6
do. 4½ Pref.	5	4½	4½	4⅛	—	5 9 10
India-Rubber	1	10	—	15/9	—	*7 3 4
Met.-Vickers Pref.	3	8	8	2⅛	—	6 11 0
Siemens Ord.	1	10	10	16/3	+ ⅛	Nil
Telegraph Con.	10	20	20	23½	—	*6 0 0

*Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.		Price Jan. 8.	Fortnight's Inc. or dec.
a Acid, Oxalic	per lb.	5¾d.	...
a Ammoniac, Sal	per ton	£60	...
a Ammonia, Muriate (large crystal)	,,	£52	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£25	...
a Copper Sulphate	,,	£25 10s.	...
a Potash, Chlorate	per lb.	4d. to 4¼d.	...
a ,, Perchlorate	,,	4¼d.	...
a Shellac	per cwt.	£15 15s.	...
a Sulphur, Sublimed Flowers ...	,,	£7 15s.	...
a ,, Roll	,,	£7 15s.	...
a Soda, Chlorate	per lb.	3d.	...
a ,, Crystals	per ton	£5 to £5 5s.	...
a Sodium Bichromate, casks ...	per lb.	4½d.	...
METALS, &c.			
b Aluminium, Ingots	per ton	£115 to £120	...
b ,, Wire	per lb.	1/9 to 2/6*	...
b ,, Sheet	,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—			
Grade I	per ton net	£219	...
Grade II	,, ,,	£166	...
Grade III...	,, ,,	£86	...
c Brass (rolled metal 2" to 12" basis)	per lb.	9¾d.	...
c ,, Tubes (solid drawn) ...	,,	1/0 to 1/0½d.	...
c ,, Wire, basis	,,	10½d.	...
c Copper Tubes (solid drawn) ...	,,	1/1½d.	...
c ,, Bars (best selected) ...	per ton	£95	...
c ,, Sheet	,,	£95	...
c ,, Rod	,,	£95	...
d ,, (Electrolytic) Bars ...	,,	£67 10s.	15/- dec.
d ,, ,, Sheets ...	,,	£145 10s.	...
d ,, ,, Wire Rods ...	,,	£77 10s.	15/- dec.
d ,, ,, H.C. Wire	per lb.	9½d.	¼d. dec.
f Ebonite Rod	,,	8/6	...
f ,, Sheet	,,	8/-	...
n German Silver Wire	,,	2/3	...
h Gutta-percha, fine	,,	8/6	2/- inc.
h India-rubber, Para fine	,,	1/0½	...
Iron Pig (Cleveland Warrants) ...	per ton	£5 2s. to £5 2s. 6d.	...
f ,, Wire, galv. No. 8, P.O. qual.	,,	£25	...
g Lead, English Pig	,,	£32 5s.	10/- dec.
g Mercury	per bot.	£9 12s. 6d. to £9 15s.	2/6 to 5/- dec.
e Mica (in original cases) small ...	per lb.	3d. to 8/-	...
e ,, ,, medium...	,,	4/- to 8/-	...
e ,, ,, large ...	,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings	,,	1/3	...
p ,, drawn bars and rods	,,	1/2½	...
p ,, rolled strip & sheet	,,	1/2½	...
p ,, wire	,,	1/3½	...
o Platinum	per oz.	£25	...
d Silicium Bronze Wire	per lb.	1/0½	...
r Steel, Magnet, in bars	,,	10d.	...
n Tin, Block (English)	per ton	£243 to £243 10s.	£7 10s. inc.
n ,, Wire, Nos. 1 to 16 ...	per lb.	3 9	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
j Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Shaft Currents in Electric Machines.—In an American I.E.E. paper, Messrs. P. L. Alger and H. W. Samson, both of the American G.E. Co., describe the causes of, and remedies for, the existence of shaft or bearing currents which sometimes flow across the rubbing surfaces and the bearings of electrical machinery, thereby damaging the shaft and bearings.

It is concluded that the most important cause of shaft currents is the presence of some dissymmetry in the magnetic circuits of the rotor or stator core, which causes more flux to flow in one of the two parallel (right and left hand) paths than in the other, and so gives a resultant flux linking the shaft. The most prominent causes of such dissymmetries are sectionalised frames and segmental punchings. All cases where such divisions of the yoke will cause excessive bearing currents can be predicted by means of rules given in the paper, but the use of any sections or segments at all will give rise to some shaft voltages, due to the impossibility of making all joints exactly alike. These secondary shaft currents should not be harmful except in extremely high-speed machines like turbine alternators. The most effective methods of remedying bearing currents, other than insulating, are to punch holes in the yoke in the regions of low reluctance, thus raising all parts of the yoke to the same level of reluctance, or to create a separate flux linking the shaft and opposed to the flux produced by dissymetry, or to make use of offset segmental punchings. It is believed that the use of offset segmental punchings will effectively cure all ordinary cases of bearing currents in small induction motors, d-c. machines, converters, and synchronous motors, and, as offsetting the dovetails gives better core loss, lower yoke reluctance, and a more solid core construction, with very little expense or trouble (once the new dies are developed), it is recommended that this scheme be adopted whenever practicable.

The subject was discussed in the ELECTRICAL REVIEW of October 5th, 1923, by Dr. A. Fraenckel.

The Westminster Salvage Plant.

MANY local authorities already have house refuse subjected to sorting processes, but not all of them perform the work so thoroughly as the Westminster City Council. The Council's area is a very wide one, and the daily load of unwanted matter collected by the City sanitary department amounts at times to as much as 100 tons per day; it rarely falls below 70 tons. It can readily be imagined that amongst such a large amount there are many tons of material which will pay for recovery, and the salvage plant which the Council has had installed performs this work in a very satisfactory way.

FIG 1.—GENERAL VIEW OF PLANT.

The plant is designed to deal with a maximum of 100 tons of refuse per day. The loaded lorries enter the building and are weighed on a 20-ton Avery weighbridge, and they then discharge their contents into a pit in which a grid prevents the passing of exceptionally large articles. The material is then fed by means of a combined rotary feeder and separator on to a belt conveyor. The apex of the receiving hopper, the rotary feeder, and the loading end of the conveyor are installed in a separate chamber with a dust collecting equipment consisting of a "Duper" centrifugal fan fitted with a 12½in. inlet and driven by a 5-h.p. motor. The conveyor belt is 2 ft. 6 in. wide and of balata. Steel framework supports the rollers and tension gear, and there are timber platforms alongside for the band pickers who remove rags, bottles, bones, and other saleable articles. At the top of the conveyor is a magnetic drum which takes the tins from the belt, and they drop through a chute to a baling press. At the same point a paper collecting plant comes into play. This consists of a "Duper" centrifugal fan, supplied by Messrs. David Rowell & Co., Ltd., fitted with a heavy steel impeller, the necessary suction and delivery pipes, and a cyclone settler for the paper. The fan is driven by a direct-coupled 8-h.p. motor. From the cyclone the material is charged into a press and baled for disposal. Both tin and paper presses are of the "Bijoli" type manufactured by Messrs. Shirtliff Bros., Ltd. They are arranged to be driven by a direct-coupled 4-h.p. motor with push-button control, and they have an automatic brake to hold the load in all positions, and limit switches.

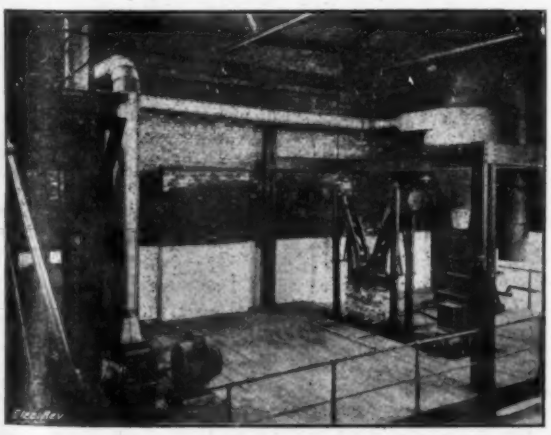


FIG. 2.—BALING PRESS AND PAPER-SUCTION PLANT.

The remainder of the material from the conveyor passes into a revolving screen in which it is divided into three sizes for further treatment. The smallest size, which passes through the first section of the screen, is carried by a water trough into a specially-designed Coppée washer, where the cinders and combustible matter are separated from the heavy material—clinker, glass, stone, &c. The lighter material from the washer is delivered by means of a chute into a suitable draining apparatus, where the water is eliminated and the material falls into a bunker for loading directly into motor lorries for transit. The heavier materials are taken from the washer by means of an elevator, which also serves to eliminate the water, and discharged into a separate bunker. The intermediate product from the revolving screen is also conveyed by a trough to a washer, where separation of heavy material and combustible matter takes place as in the previous case. The lighter products pass into a de-watering sieve, and thence into a separate loading bunker, while the heavier materials from both washers pass into the same bunker. The materials which pass over the screen are discharged through a chute into a pulveriser, which produces a material suitable for utilisation as manure. The washers are built in cast iron, and are operated by means of compressed air supplied by a blower. The pulveriser is of the swing-hammer type, manufactured by the Patent Lightning Crusher Co., Ltd., and is so designed that the material is crushed to a very fine degree by means of hammers revolving at a high speed (about 1,000 r.p.m.) inside a heavy cast-iron casing. The machine is driven through shafting and belt by a 50-h.p. motor.

The necessary water is drawn from a creek and circulated by means of a "Gwynne" centrifugal pump driven by a 14-h.p. motor. The power required for the elevating, screening, washing apparatus, &c., is provided by a 25-h.p. motor and transmitted by shafting and belting.

Fig. 1 is a general view of the installation, showing the conveyor and the galleries on which the operating gear is mounted. Fig. 2 illustrates the lower gallery bearing the tin-baling press and the paper-collecting gear, and fig. 3 shows the revolving screen, water troughs and tanks, and the elevator which conveys the heavy materials from the tanks.

The plant was installed by the Coppée Company (Great Britain), Ltd., in consultation with Capt. F. W. Cable, M.C., A.M.Inst.C.E., Chief of the City Highways Department. The whole of the electrical equipment was supplied by the General Electric Co., Ltd.

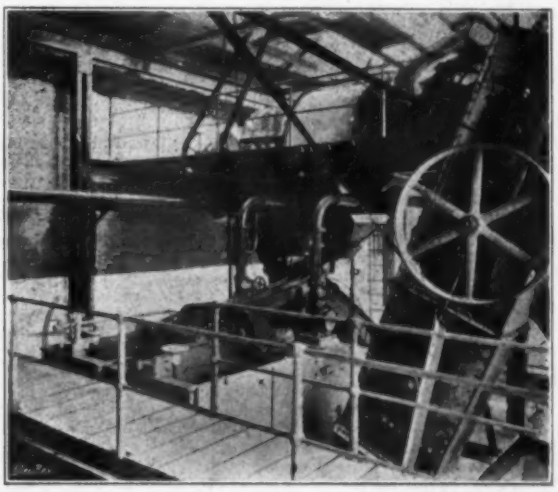


FIG. 3.—REVOLVING SCREEN AND ASH TANKS.

It may be of interest to our readers to learn that amongst the material recovered in the station daily are two tons of paper, five tons of large cinders (calorific value 11,600 B.th.u. per lb., ash 20.4 per cent.); twelve tons of large washed cinders (7,990 B.th.u. per lb., ash 31.74 per cent.); and fifteen tons of fine washed cinders (7,840 B.th.u. per lb.; ash 30.29 per cent.).

The Control and Switching of High-Pressure Distribution Systems.

By P. V. HUNTER, C.B.E., M.I.E.E.

(*Abstract of paper read before the* SOCIETE FRANCAISE DES ELECTRICIENS.)

FOR the purpose of this paper consideration of the subject will be limited to the methods and arrangements necessary to secure the uninterrupted supply of electricity, so far as this can be done by selectively switching feeders and apparatus in and out of circuit.

Large modern systems have reached a degree of complication and elaboration far beyond that necessary for the bare essential of giving supply with the maximum efficiency, and the additional complications can only be justified on the ground that they are necessary for the purpose of making the supply reliable.

It is improbable that cables have a less factor of safety or break more frequently than the water pipes used for general water supply, although in the case of the latter no elaborate precautions are necessary to deal with a breakdown. The fundamental difference which lies at the root of the electrical problem is the high efficiency of transmission. This results in the concentration of large quantities of energy at any point of breakdown and a general dislocation of supply until the breakdown is remedied. In the electrical case every disturbance affects the whole corporate system, whereas in other systems disturbances are of local significance only.

The purpose of control and switching is to confine local trouble to local limits, and it is with this object that the complications referred to have been adopted.

Switchgear designers now thoroughly appreciate that normal load is to them unimportant, and what they have to design their equipment for is the conditions which exist under a short circuit. Switches which fail to open, or relays which disconnect healthy apparatus under the rush of current produced by a short circuit, are both useless, no matter how admirably they may appear to function under normal load conditions.

In the case of small distribution systems faults are infrequent and the number of people affected and the amount of damage caused are relatively unimportant, even in the case of a complete temporary interruption of supply to all consumers. The conditions change, however, as the system grows. When it is four times its previous size the number of faults will be four times as great, and if each fault affects the whole system, and there are four times the number of consumers, it follows that in a year the extent of the damage caused to consumers by faults is likely to be sixteen times as great as in the case first considered.

From the point of view of the designer trying to protect the consumer from trouble, the case is even worse than this as in the larger systems the severity of short circuits is greater on account of the larger kinetic energy of the system.

The conclusion appears to be inevitable that the value to the community of arrangements confining disturbances to local limits increases as the system grows, and is approximately proportional to the square of the size of the system involved.

The commercial justification for discriminating switching arrangements is therefore clear in the case of large systems, but it is equally obvious that in the case of small networks the cost of elaborate precautions may not be justified.

The interesting engineering problem is the case of the large system where it is necessary in all circumstances, and practically regardless of cost, to avoid general interruption of supply. As a preliminary to consideration of the methods to adopt for this purpose it is necessary to examine the nature and origin of any possible disturbances which it is necessary to guard against. Experience shows that the complications of modern systems do not of themselves introduce special weakness. A distribution system fed from several stations in parallel is not more liable to faults than if it were fed by the same amount of generating plant concentrated in one station; similarly, the number of faults does not increase at a greater rate than the mileage of feeders or the number of sub-stations.

Careful examination of records will show that disturbances to supply almost invariably arise either from accidental damage to apparatus or from mistakes in operation. Trouble due to failure of apparatus from inherent weakness or unsatisfactory design is in modern systems comparatively rare, and when rectified is not liable to recur.

Mistakes in operation can be eliminated by safeguards and interlocks, but faults due to apparatus being damaged, generally by some external cause or accident, cannot be prevented. The consequences of such a fault will be immediately felt throughout the electrical system, and if adequate arrangements to deal with it are not immediately operative a serious interruption of supply will result.

To meet these difficulties two mutually-helpful methods are available. First, automatic circuit-breakers responsive to fault conditions may be arranged so as automatically to isolate from the system the section containing the fault. Secondly, operative control of switching may be provided promptly to restore to service feeders or apparatus found to have been isolated unnecessarily.

The trend of modern development is to make the automatic switches more sharply discriminating in their action, and to improve control of switching by keeping the operators informed of the condition of the system at all times, and giving them facilities for rapidly carrying into effect the necessary operations.

There is obviously room for difference in practice by different organisations in achieving these desired results. Some will rely almost entirely on the ability of the control staff to restore normal conditions by rapidly ascertaining the extent of a disturbance and making the necessary switching operations. Others will prefer to try and make the automatic action of the switches so intelligently discriminative that sound apparatus or feeders will not be switched out of circuit and only the one containing the fault will be isolated.

It should not, however, be rashly assumed that preference for one arrangement over the other is a matter merely of personal idiosyncracy; close examination of any particular system will generally produce distinct reasons for the use of one method rather than the other. It is interesting to note, however, that up to the present no practical arrangements have been proposed with the object of automatically switching back into circuit any feeder or transformer which has been isolated unnecessarily by faulty discrimination of the automatic switches. Automatic arrangements have been confined to switching apparatus out of circuit and indicating to the operating staff the condition of the system.

In the case of large systems it has been almost universally found necessary to adopt central control of switching. This is done to avoid the confusion which arises in an emergency when operators in different stations and switching centres have conflicting ideas as to the best method of restoring normal conditions. The arrangement is that in a central room, conveniently placed from the point of view of communications, control of all switching is established. The engineer in the central control room is a dictator and in sole charge of switching throughout the system. Without his permission nothing may be done by the staff in the way of connecting apparatus in and out of circuit.

An admirable description of the control arrangements of the large modern high-pressure distribution system of the New York Edison Co. is given by W. H. Lawrence in the March, 1923, issue of the *General Electric Review*. In addition to the usual telephonic communication to all sub-stations and switching centres a complete and ingenious system is provided for indicating in the control room, automatically, the condition of all high-pressure switches.

The control engineer is, therefore, immediately informed of the opening of switches, and is, moreover, able to see for himself that his switching instructions are correctly carried out without delay, all of which must be of the greatest value in emergency and reduce the length of time taken to restore normal conditions.

The system of signalling instructions to the sub-station attendants in emergency according to a pre-arranged code, also described, is of considerable interest.

In Great Britain the development of automatic indicating equipment is in a much more elementary stage. At the present time nothing has been done in the direction of transmitting automatically a record of the operation of sub-station switches. An ingenious system has, however, been adopted by the North-East Coast power companies for indicating in the central control room the loads on the different power stations, giving the true power, wattless power, and power factor. To enable the indications to be transmitted readily, the arrangement relies on the production of direct-current pressures by thermopiles heated by coils carrying currents proportional to the loads to be indicated. The use of thermopiles and direct current for this purpose, makes it possible to employ small and lightly-insulated wires, such as telephone conductors for transmitting the indications, and the loads of any number of generators may be added together simply by connecting their thermopiles in a common circuit.*

The principal effort in Great Britain has been to solve the problem of automatic switching. The endeavour is to make the switches so selective and discriminating in their action that on the occurrence of a fault only the feeder or trans-

* See ELECTRICAL REVIEW, October 26th, 1923, p. 608.—EDS.

former containing the fault will be switched out of service, and the operation performed so quickly as to avoid serious shock to the system.

The difficulties associated with the problem lie in preventing the switches of sound apparatus from responding to the fault current. It is this difficulty, no doubt, which has led American engineers to elaborate their arrangements for obtaining an instantaneous indication in the control room of the opening of switches. To meet this difficulty the endeavour has been to make the switches respond only to current leaking from the particular feeder or apparatus controlled.

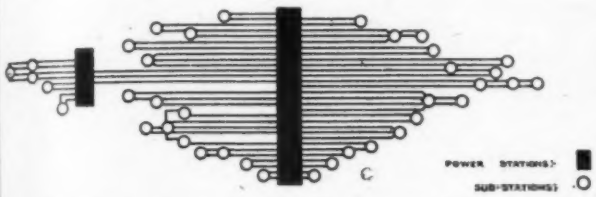


FIG. 1.—UNDERGROUND ELECTRIC RAILWAYS OF LONDON HIGH-PRESSURE DISTRIBUTION SYSTEM.

The Merz Price system was the first development which gave real discrimination in this way, but since that date (about twenty years ago) many different ideas have been developed or proposed. They, however, all have the feature in common that some special conductors are required for the purpose of securing the discriminative action. A very comprehensive description of the various forms will be found in Wedmore's paper of January, 1915, before the Institution of Electrical Engineers. Since the date of this paper, the Merz Price system has been improved by arrangements overcoming the difficulty caused by the pilot cable capacity current, which tended to make the switches operate on severe overload. In addition, a new arrangement, known as the "Four-conductor Protective System," has been developed commercially. Additional conductors are still required for the purpose of obtaining the discriminating action, but the number is reduced to the minimum possible, namely, one for each three-phase circuit.

When properly constructed and installed it is possible with a discriminating protective system to ensure the immediate disconnection of faulty feeders, and that sound apparatus will not be improperly switched out of service under any conditions, but, even so, the ideal of absolute continuity of supply is not completely ensured.

The automatic switches have to be associated together at junction points of the distribution system, and connected by a common busbar. This busbar is liable to defeat the whole object of the automatic arrangements, since it cannot be dispensed with, and in the event of a fault on the busbar, supply to a large section of the system is affected.

So far no serious proposals have been made to provide duplicate busbars with selective arrangements changing over automatically from one busbar to the other in the event of a busbar fault, and even such elaborate arrangements would be ineffective in the event of any oil switch bursting or failing to interrupt circuit. A busbar breakdown is, therefore, the most serious kind of fault which can occur in a modern distribution system.

Discriminating devices responsive only to faults in the apparatus they control will obviously ignore a busbar fault, and to deal with this some special provision is necessary. The best arrangement is probably to provide excess-current relays at suitable points, so adjusted that they do not come into operation until the excess current has lasted a definite minimum time, sufficient to allow the discriminating protection to function. In the case of ordinary faults in apparatus, therefore, the excess-current devices will never come into action.

Excess-current relays are only moderately selective in their action, even when the settings are carefully graded according to the position of the relay in the system, but this is not of serious consequence if they operate only in the very exceptional case of a busbar fault or its equivalent. There is, however, a great need for a simple and reliable overload relay in which the minimum time setting is closely adjustable. The ideal would be one which could be adjusted from 10 cycles to, say, 100 cycles in steps of one cycle.

In view of the present tendency to use switches with a very quick break, it is generally impossible to assume that 20 cycles will allow ample time for the combined action of discriminating protective gear and oil switch to clear a fault, and if this has not been done by the end of half a second it is time for the excess-current relay to come into operation. Even closer settings are permissible in cases where the problem has been carefully considered.

Notwithstanding their very elementary discriminating properties, overload relays used in this way may be very effective in keeping to reasonable limits what otherwise might be a complete interruption of supply on the occurrence of a busbar fault.

As explained earlier, there is room for considerable difference in the detailed methods adopted to prevent interruption of supply in the event of a local breakdown, depending on whether it is preferred to rely mainly on the discrimination of the control staff, or on that of the automatic devices.

The issue is not, however, so simple as this statement would imply, as it will generally be found that where less reliance is placed on discriminating devices, there is a tendency to arrange the network so as to assist the human element either by avoiding interconnection of sub-stations or the provision of special tie lines between power stations.

In order that this aspect of the matter may be followed more clearly, diagrams have been prepared illustrating three systems which are more or less typical of the different methods of treatment.

Fig. 1 is a diagram of the high-pressure distribution system of the Underground Railways of London, in which it will be noted that the tendency is to feed each sub-station independently from the power station and not to interconnect sub-stations. At the time when this system was designed, no automatic discriminating protective systems were in existence, and the discrimination of such devices as were available was known to be faulty in the extreme when applied to interconnected systems. The system may be classified, therefore, as one which places the minimum reliance on automatic devices. It requires, however, a large provision in spare feeders, which, in the network shown, is approximately 40 per cent.

Fig. 2 shows the arrangement of a large modern American system, viz., that of the New York Edison Co., the control of which is referred to earlier. This system relies largely on automatic switches, as is shown by the way in which sub-stations are connected together, so that the high-pressure distribution system forms a network, but it is clear from the description of the control-room equipment that the discrimination of the switches is not expected to be sufficiently close to prevent healthy apparatus from being automatically switched out of service when there is a disturbance. The

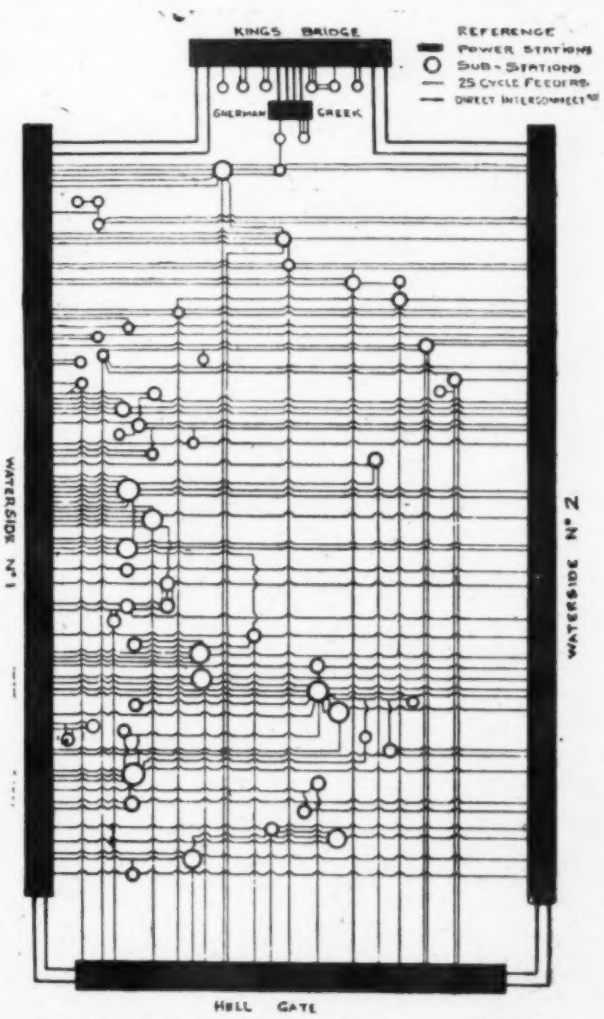


FIG. 2.—NEW YORK EDISON CO. HIGH-PRESSURE 25-CYCLE DISTRIBUTION SYSTEM.

use of direct interconnection or ties between power stations is also of special significance, as they are relied on to remain in service in emergency when network feeders are liable to be switched off indiscriminately owing to the rush of current and lack of selective action of the switches. In such circumstances direct interconnectors are not so much affected by the

rush of current, and being less liable, therefore, to be switched out of circuit, may be relied on to keep the system in parallel and limit the extent of the disturbance.

Power station interconnectors are also used for regulating the load between power stations, but for this particular purpose each interconnector is much more effective if it is connected to the distribution system at a point, preferably midway, between the two stations it connects. Load can then be transferred with much less voltage regulation, and when feeding from both ends into the system the interconnector carries twice the load which would be possible if it were taken directly from station to station. Connecting it to the distribution system in this way, however, renders an interconnector liable to disturbance by current rushing through it to a fault on the distribution system. It is necessary, therefore, that such interconnectors should be controlled by discriminating protective gear which is unresponsive to any kind of overload.

Fig. 3 shows the network of the North-East Coast power system of England, where very great reliance is placed on discriminating protection. This will be seen from the complicated nature of the network and the large number of power stations which operate in parallel without the use of direct interconnectors. In the case of this system everything tends to recommend the use of discriminating devices. The area served is large; the power stations are so far apart that the

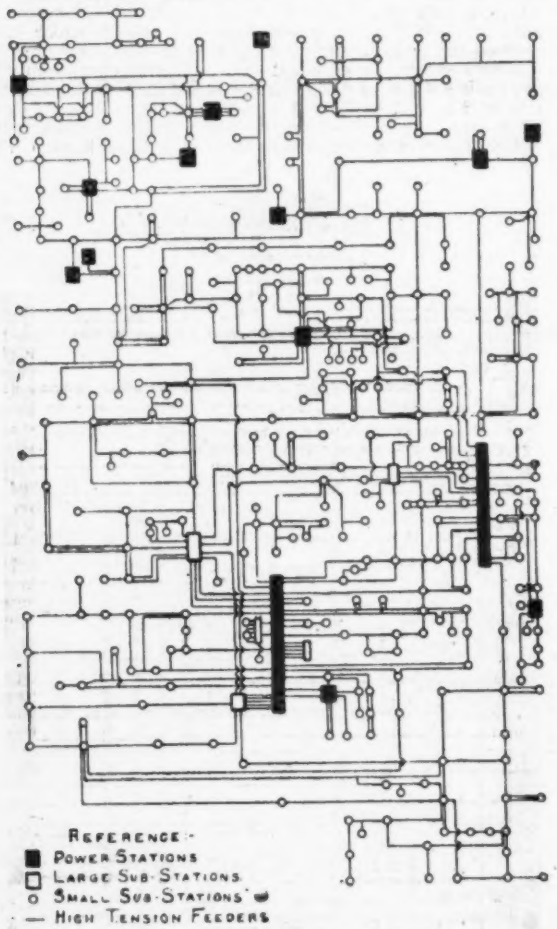


FIG. 3.—NORTH-EAST COAST HIGH-PRESSURE DISTRIBUTION SYSTEM.

cost of direct interconnectors would be excessive; and in addition the great majority of the sub-stations are static and have no operators in continuous attendance. This combination of conditions makes discriminating protection essential, as without it a reliable supply would not be commercially possible.

The conditions of the New York system are, however, in complete contrast, as a larger load is handled by a smaller number of power stations, comparatively close together in a smaller area, and the sub-stations are each fed direct from at least two power stations, and have continuous attendance. All of these conditions facilitate the use of direct power station interconnectors and operative control of switching.

Up to the present time no system appears to have been constructed taking full advantage of all the means available, *i.e.*, using discriminating protection in combination with automatic indication and code signalling, and it is probably a matter for satisfaction that this possibility of improved working is in reserve and available to meet the more onerous conditions towards which electrical developments appear to be moving.

The advantage of combining the electrical systems of a large area into a single organisation, appears not to have reached its economic limit. We may expect, therefore, to see systems in the future more extensive in area and dealing with much larger loads than anything now contemplated. Successfully to control such systems will probably require in the completest combination all practicable safeguards known to the present-day electrical engineer.

It may be justly contended that elaborate provision of the kind considered is largely ineffective if the switches themselves cannot be relied on to open circuit in emergency without failure, and it is undoubtedly true that there is room for a great deal of improvement in this direction. At the present time the tendency of switchgear makers is to strengthen the switches so as to meet the explosive pressures produced internally under short circuits and to increase the speed of opening of the contacts, but progress has been largely a matter of conjecture and rule of thumb.

It is greatly to be hoped, therefore, that research, including that now undertaken by the British Electrical and Allied Industries Research Association, among others, will throw more light on the essential mechanism of the whole phenomena of current interruption by switches.

In the meantime an interesting development in the direction of reducing the severity of the service required of switches, is the construction of transmission systems employing single-core cables exclusively. By using single-phase transformers and taking suitable precautions in the arrangement of the switchgear, it is possible to ensure that all faults are to earth and none between phases. This feature should prove of great advantage, as the general experience of those operating high-pressure systems is that faults to earth do not produce such severe shocks as faults between phases, and are, therefore, not so difficult to deal with. This is due largely to the use of neutral resistances, which prevent the fault current reaching such a destructive value as occurs in the case of faults between phases.

By far the most important and interesting system of this kind which has so far been constructed, is the 60,000-volt system recently installed in Paris in connection with the unification of the electricity supply of the city, and switchgear engineers throughout the world will await the result of extended commercial experience of this system with very great interest indeed.

(To be concluded.)

The Electrical Industry in China.

WE have consistently expressed in these columns the opinion that there is a large amount of electrical business to be done in China, notwithstanding the unsettled condition of that country. This opinion is shared by foreign manufacturers, Germans amongst them, and it is evident that there is and will be keen competition in this important field. In a leading article on the subject, the *Hamburger Nachrichten* states that the electrical industry in China has made astonishing progress during the last year or two, hardly a week passing without a new supply station being built or designed in one or other of the towns in the interior. Existing stations are increasing their capacity rapidly. German firms, it is stated, have secured a gratifying share in the orders involved by these developments.

The total number of electricity supply undertakings in China was 168 at the end of 1920 and is now about 200, including some 50 works under foreign management. Japan is the most interested of the foreign nations concerned, and has invested more than 200,000,000 yen (about £20,000,000) in the electrical industry of Manchuria alone.

There are in Canton 22 supply companies (including 13 Chinese concerns) which deliver about 12,000 kW to a connected load of about 3,000,000 lamps or their equivalent. Most of the prime movers are oil engines, only two stations burning coal, and only four of these plants exceed 1,000 kW. The electric tramway in Canton is British.

At the end of 1922 there were in the province of Kiangsu more than 60, in Chekiang 10, in Anhui 6, and in Fukien 9 electricity works, besides a number under construction. Most of these installations are of 50 to 200 kW capacity, but in almost every case extensions are in progress, and the equipment of new stations is being proportioned on a larger scale from the outset.

In Shanghai there are 19 electric light and power companies, mostly Chinese, with a total capacity of some 25,000 kW. A French company with a capital of 8,000,000 fr. produces 1,500 kW. The number of lamps connected, about 1,000,000, is less than in Canton, but the power load is heavier in Shanghai, where the cotton mills are responsible for an important demand.

In Hupeh there are 13, and in Hunan four electricity stations. The Hankow Light & Power Co. supplies the English, French and Russian concessions and the Hankow waterworks with light and power, whilst the German residents are supplied from the plant of the firm of Melchers and

Co. The Hankow waterworks recently ordered two 3,200-kW turbo-generators from Mannheim. The value of the imports of electrical materials into Hankow was 636,000 Hk.-taels in 1921 and 225,000 Hk.-taels for the first nine months of 1922. According to *Hamburger Nachrichten* German firms secured a large share of this business.

In Shantung there are nine electricity works, including one in Tsinanfu (under German management) with a capital of $1,000,000 and 130 employés. At present 40,000 lamps are supplied. The Tsiningchou works, founded in 1918 with $180,000 capital, since increased to $200,000, supplies 4,000 lamps (compared with 1,000 initially) and extensions are already required.

The Tsingtau station, now operated municipally, possesses 2,710 h.p., and is being enlarged to 3,300 kW. Other stations are in Fangtse (Chinese owned, capital $30,000); Poshan (capital $125,000); Tenghsien (capital $60,000); Chefoo (capital $110,000); Lungkou and Choutsun, as well as at two collieries.

Of 15 stations in South Manchuria 13 are Japanese owned, but there are Chinese interests therein. About 35,000 kW is developed and this output is absorbed mainly by industrial and traction loads. The South Manchurian Railway Co. is the largest undertaking. It operates *inter alia* a 25-mile tramway system and owns in Dairen two power stations of 6,000 and 1,500 kW respectively, one in Mukden of 1,400 kW, one in Changchun of 2,250 kW, and one in Antung of 1,480-kW capacity. The last-named is to be increased by 600 kW in order to deliver energy over the Yalu to Korea. In Fushun and Anshan there are other stations; that at Fushun supplies the district up to Mukden and the lines are to be extended to Liaoyang. The Anshan station develops 3,000 kW. The Penshihu Ironworks has a 5,500-kW station, and in 20 small installations about 10,000 kW is developed.

The brisk demand for lighting and power installations has led to the commencement of electrical manufacturing in China. Thus the China General Edison Co. (Shanghai), affiliated to the General Electric Co., of New York, makes from 15,000 to 20,000 glow lamps per day, as well as telephone and telegraph apparatus with all accessories. Two other Chinese factories make 3,000 lamps a day, and the Wah Son Electric Manufacturing Co. builds motors, dynamos, transformers, switchgear, &c., to the annual value of 500,000 taels (about £66,000).

Metropolitan-Vickers Mining Switchgear.

SOME RECENT PRODUCTS.

RECOGNISING South Wales as essentially a colliery district, the Metropolitan-Vickers Electrical Co., Ltd., departed from its usual practice of exhibiting a general line of apparatus and specialised on colliery gear at the recent Mining Engineering Exhibition at Cardiff. Much of the switchgear was of quite recent design, and practically made its first appearance at the show; therefore the following particulars concerning some of the gear will not be out of place.

A liquid controller (type LC) for a.c. slip-ring motors driving winders, haulage gear, and the like is illustrated in figs. 1 & 2. It is suitable for rotor currents up to 1,000 A at 800 V and for stator currents up to 250 A at 3,300 V with oil-break contactors, or up to 500 A at 650 V with air-break contactors, and is, of course, of either flame-proof or normal patterns. The first view shows the apparatus to consist of a gate type operating lever, master switch, electrically-operated oil-immersed reversing contactor to control the stator circuit, and a liquid controller for the rotor.

The operating mechanism is of simple design, and substantially constructed. The movement of the lever is so arranged that the lever is checked in the off position, and at the points where the master switch causes the stator contactor to close in either direction. At these points all resistance is connected in the rotor circuit, and a creeping speed is obtained. A throw-over catch prevents inadvertent movement. The master switch is of the drum pattern fitted with controller type contact fingers, operating under oil. The use of electrically-operated contactors to control the stator circuit of the motor allows shorter cables to be used, light control wires only being brought to the master switch, gives quick closing and opening of contacts, and reduces greatly the effort required to work the operating lever.

The liquid controller is shown in fig. 2. In principle, it consists of three fixed electrodes connected to the slip rings of the motor, and three moving electrodes connected together to form a neutral point. Each pair of electrodes is placed in an insulated steel tube containing the electrolyte. The construction gives equal distances in all positions between each pair of electrodes, thus ensuring balanced phases. The tank is filled completely with electrolyte, giving a large body of liquid with great thermal capacity. Moreover, water-tightness is maintained easily by three simple packed glands round the connection rods from the fixed electrodes. The various parts are placed so as to secure natural circulation of the liquid. The heated liquid rises to the top of the resistance tubes, flows over the top, and through the condenser type coolers down to the bottom of the tank. The liquid re-enters each resistance tube through a hole provided in the centre of a composition block on which the fixed electrode is supported.

The tank has electrically-welded joints; two sheet-iron covers give access to the interior, and removable side plates give access to terminals provided with sockets to receive the incoming cables.

The operating mechanism includes no chains, wire ropes, or gear wheels. At each side of the tank malleable cast-iron balance levers are mounted with ball bearings, and counterweights balance the weight of all moving parts of the controller exactly.

The electrodes consist of grouped plates, and are prevented from touching when in the closed position by insulating guides, but mesh very closely to leave a minimum resistance in circuit. As all electrodes are fully immersed and no contacts made or broken, in air, no open sparking can take place, so that flame-proof enclosure is not necessary. The resistance tubes are of rectangular section, and are constructed of heavy-gauge sheet steel, reinforced externally, and internally lined with a tough insulating material that is not acted upon chemically by the electrolyte, and is not affected by the changes in temperature that occur within the controller.

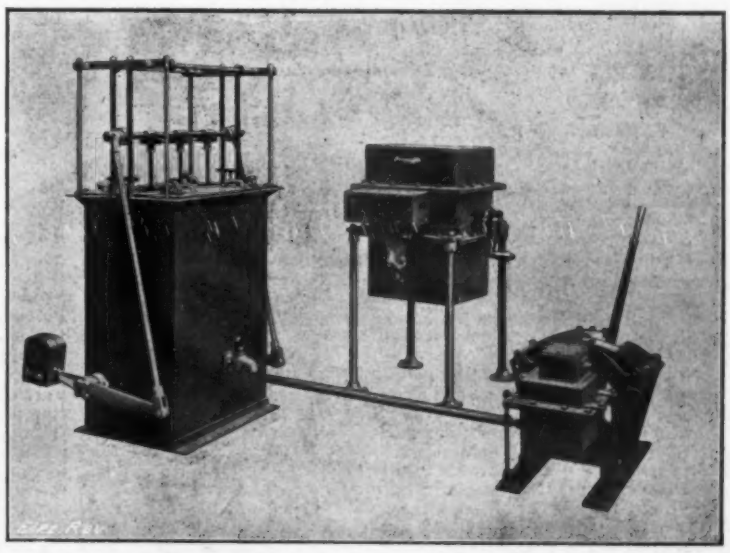


FIG. 1.—METROPOLITAN-VICKERS LIQUID CONTROL GEAR.

To dissipate the heat, cold water is circulated through the tubes of separate self-contained condenser type cooling units. Approximately 3.3 gallons per horse-power dissipated per hour are required for normal service. Two cooler units are supplied normally with all except the smallest controller frame. The coolers are simple, consisting of straight brass tubes mounted between cast-iron water boxes. By arranging the external water connections suitably, one unit may be retained in service while the other is cleaned. Pulleys are provided on the tank superstructure by means of which the coolers may be lifted.

The resistance liquid consists of a solution of carbonate of soda (common washing soda) in water.

It is recommended that with all type L.C. control equipments an automatic oil circuit breaker be connected between the line and the stator reversing contactor.

Another exhibit was the flame-proof (type SF) switch pillar for pressures up to 3,300 V and 100, 250, and 400 A, shown

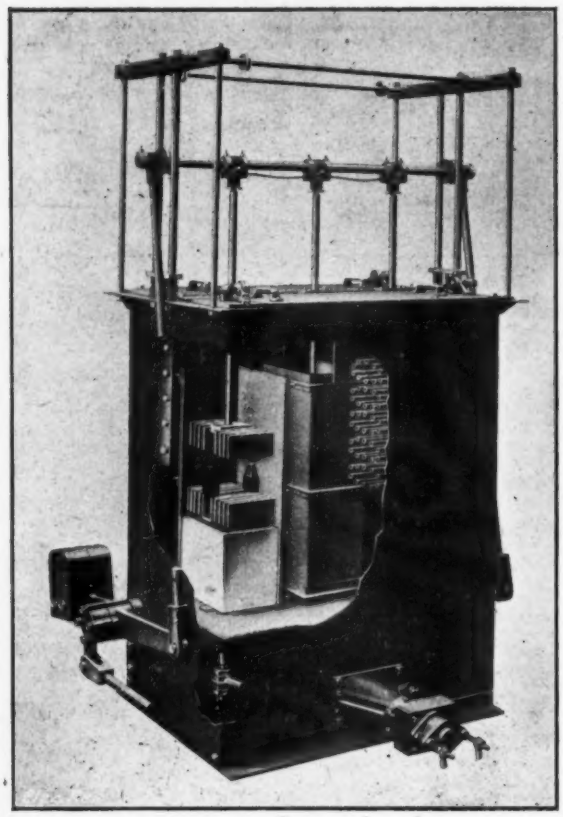


FIG. 2.—LIQUID CONTROLLER.

in fig. 3. The supporting frame is constructed of cast iron, malleable iron being used for the body of the circuit-breaker. All components are jig-made, and interchangeable. The switch is fitted with plugs which engage with sockets in the connection chamber. The body or carriage slides upon steel bars fixed to the stationary pillar. When withdrawn from the sockets, the breaker and all accessories are completely isolated; the switch carriages are interchangeable with other units of similar capacity, and in the event of a breakdown may be replaced by a spare or by a similar unit from an idle pillar. A hinged "locking-off" door covers the live sockets when the switch carriage is removed.

The circuit-breaker is fitted with a loose handle, operating through a simple toggle motion upon the moving contact gear, and a high-speed break is obtained by the use of strong throw-off springs acting on the moving element.

Contact is made by a rolling action which confines any arcing to a part of the shoe which carries no current under normal conditions. The main current-carrying surfaces are in this way kept free from burning. A racking-out and tank-lowering device is fitted to the type S.F.3 unit, and the current and potential transformers are mounted in a compound-filled compartment in the switch carriage, while where a number of pillars are assembled to form a switchboard, the bus-bars and bus-bar chambers are continuous throughout. Special features are included to give automatic protection, and also guard against mistakes liable to be made by careless or unskilled operators.

Auto-transformer and star-delta (fig. 4) starters, type OL, were also amongst the exhibits. They are suitable for controlling 2- and 3-phase squirrel-cage motors under all conditions where inflammable gas is likely to be present, and are made for pressures up to 650 V in maximum sizes of from 35 to 100 h.p. The starters are provided with an oil-break drum-type switch, and the air-break isolating switch, with its mechanical interlocks, enables the starter and motor to be made dead, so that inspection, adjustments, and cleaning can be carried out with entire absence of risk. Distinctive features are: Certified flame-proof welded-steel case; compact design, requiring low head room; no exposed live parts; overload and no-volt protection; cannot be operated in wrong sequence; double break per phase under oil; spring tension, non-sticking, contacts; renewable sparking pieces; and accessibility.

A typical starter has been submitted for independent test to the Sheffield University, and a certificate has been awarded that internal explosions of methane and air did not communicate ignition to a surrounding explosive mixture. The switch is strongly constructed on the metal and insulation principle, the live parts being each clamped rigidly to two bakelite insulated steel bars. The moving contacts are mounted on a bakelite insulated steel rotating spindle. Two contacts per phase are fitted so that a double break is obtained, and ample oil depth is provided to reduce sparking wear to a minimum. The moving contacts are of hard-drawn copper of heavy section, and are forced against the fixed contacts by adjustable helical compression springs, thus giving a non-sticking construction, the moving contacts for each phase being joined by heavy flexible laminations, so that sliding supports and springs are not relied upon to carry any current.

The auto-transformer is of the air-cooled type mounted above the switch. For ready selection to suit the load at starting, alternative tappings are provided to give 50 per cent., 60 per cent., or 75 per cent. of the line voltage in the starting position of the switch. The automatic release mechanism is simple, and is fitted in the top of the switch so as to be fully accessible upon removal of the cover. A no-volt release and either two or three overload coils can be supplied, all of which engage with the tripping mechanism and act independently of each other. The overload releases can be calibrated for any overload between 25 and 100 per cent. above full-load current; they can be supplied with dashpot attachments to work on the inverse time principle, *i.e.*, the more serious the overload the more rapid the release. When dash-pots are fitted, the overload calibration ranges from 133 to 166 per cent. of the full-load amperes, with a maximum time limit of 15 seconds. A special feature of the dash-pot construction is the graphite pistons, which do not require lubrication and cannot stick.

The protective mechanism prevents wrong operation of the starter by making it impossible to move the handle into the running position except from the starting position, and compels the quick change-over from start to run required to minimise the momentary current rush that occurs when the change is made. A self-centring spring prevents the handle being left in the starting position. The isolating switch is mounted in a separate boiler-plate chamber behind the main case. The switch is of the air break drum pattern with spring tension renewable contacts, and interlocks ensure that the isolating switch cannot be opened or closed except with the starter in the off position, and prevent removal or replacement of either tank or cover except with the isolating switch open. A padlock is provided to lock the isolating switch in the off position and thereby prevent operation of the starter by unauthorised persons.

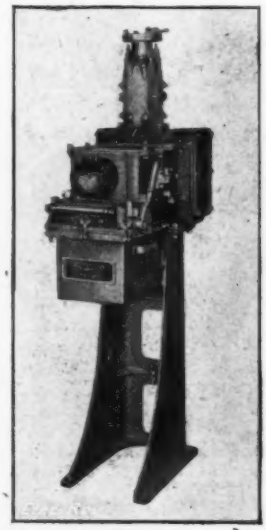


FIG. 3.—FLAME-PROOF SWITCH PILLAR.

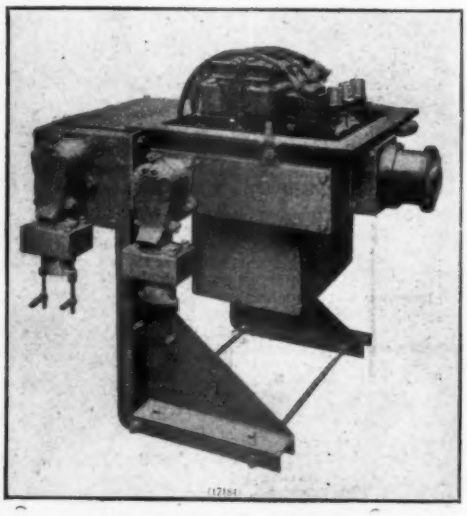


FIG. 4.—STAR-DELTA STARTER.

Accident.—Patrick Curran, of Farnworth, employed by the Lancashire Electric Power Co., was engaged repairing work on an overhead line at Radcliffe, on January 3rd, when a short-circuit was caused which resulted in an explosion. Curran was thrown from the top of the pole to the ground, sustaining severe burns to his arm and minor injuries to his head and face.

Railway Electrification in Foreign Countries.

(Abstract of lecture delivered before the INSTITUTION OF ELECTRICAL ENGINEERS.)

DR. S. PARKER SMITH lectured on the above subject at the Institution of Electrical Engineers on January 3rd, when the chair was occupied by Dr. Alexander Russell, president.

As the lecture was to deal with railway electrification in foreign countries, Dr. Smith assumed that he would not be expected to say much with regard to long-distance railways in Great Britain—not a serious hardship, for the reason that there was nothing to say on that subject. At the same time, it was a matter of very great regret that there was nothing to say.

In Austria, the position of railways after the war was so serious that it was a question of either utilising the water power of the country in order to obtain electrical working, or of the railways ceasing to work altogether. In the country now known as Austria there was ample water power, and before the war there had been some experience of electric railway working on the line running from Innsbruck to the German frontier and into Bavaria, and on one or two other lines. One of the worst problems which the Austrians had to face after the war was the working of the Arlberg tunnel line connecting Lake Constance with the Innsbruck line, which was the first to be taken in hand. At the National Convention in July, 1920, it was decided to undertake a general electrification scheme, and a five years' programme was drawn up. In July, 1923, the Arlberg tunnel line was opened. The system to be adopted generally throughout Austria was 15,000 volts, single phase, on the contact wire and a frequency of 16⅔, one of the reasons for choosing it being that there had been previous experience with this system and Austrian manufacturers were accustomed to the plant required; that system had also been found to be most economical. Power would be supplied from generating stations at Stubach and Malmitz, both river stations. Generally speaking, the Austrian Federal Railway authorities were erecting their own power stations.

In France, said Dr. Smith, the scheme of electrification decided upon was probably the most magnificent of all countries, in extent. He mentioned some of the details of the Midi Railway scheme referred to in the paper by M. A. Bachellery (read before the Institution on November 22nd, 1923), and added that the 20 years' programme which had been mapped out was far beyond anything which any other country had hitherto attempted. The Midi Railway Co. had done more than any other company in France. In the Lyons area very little had been done, but it was hoped to get to work around Nice. The Paris-Orleans line had been electrified, and it was hoped eventually to get down to Toulouse. There was a very large amount of water power available in France, and near Paris there was the large steam power station recently opened at Gennevilliers. Dr. Smith also mentioned the general scheme by which power would be supplied to railways and also for general purposes, as outlined in M. Bachellery's paper. The goods locomotives in France had been more or less standardised on American lines, but for express work several types were being built for experimental purposes.

In Holland, it was the intention originally to use single-phase power, and for a short time there was a single-phase line working between Scheveningen and Rotterdam. On further consideration, however, it was decided that in order to utilise existing power stations, the distances being relatively short and the country a small one, it would be better to adopt the 1,500-volt d.c. system. One of the decisive factors in the adoption of d.c. was the great use made in Holland of the railways for communication circuits, and it would have been a serious matter to remove them. Therefore it had been decided to proceed with the electrification of the Rotterdam-Amsterdam line on the d.c. system. With regard to the mode of collection, some discussion had taken place on whether it was best to collect from overhead wires or a third rail. The French did not know any better than they in England did which was the better system; in fact, when using 1,500 volts, d.c., it was hard to decide, and all the rolling stock in France had been made suitable for either method of collection; on some of the lines both systems were used in various sections.

The German railways were federalised in 1920, although previously they had been State railways. The coal position was not much easier in Germany than in other Continental countries, and an inquiry was instituted as to what would be the best system of electrification. The result was that the use of the single-phase system, which had already been adopted for certain lines, was confirmed, with the exception of the Berlin lines, which were a special case. It was intended originally to make the Berlin lines part of the general suburban scheme in order to utilise the existing rolling stock, but that was found to be unsuitable owing to the enormous post-war increase in the traffic, and it was necessary to use motor coaches. When that was done, it was found to be better to use d.c. than a.c., because not only could the d.c. equipment be made to meet the demands of the denser traffic better, but it was also cheaper. Therefore, it had been decided to equip the Berlin suburban lines with 800 volts d.c., third rail, the rest of the system to be single phase throughout. This was different from the French system, but perhaps it was only reasonable that if one of those two countries adopted one system, the other would adopt another. Both systems, however, were entirely satisfactory. Considerable extensions had been going on in Germany, and Dr. Smith drew attention to the different methods adopted in France and Germany for dealing with interference with communication circuits. The French adopted the d.c. system because it interfered less with communication circuits, whilst the German view was that a high-pressure circuit in any case ought not to be near a communication circuit. Both systems were sound technically, and it was difficult in many cases to determine which was the better financially for any particular set of circumstances. It depended to a large extent on subsidiary questions; whether the communication circuits were to be removed, on the one hand, or, on the other, how much was going to be spent to prevent electrolytic troubles. The Germans decided to remove the communication circuits where necessary. In Prussia, considerable railway electrification work was being carried out, power being obtained from stations burning lignite coal in some cases.

In Bavaria an enormous ring main was to be built right round the country, from Munich in the south to Nuremburg in the north. It was to be a 100,000-volt system and electricity would be fed into the ring main from hydro-electric power stations. The traction generating plant would be separate from the plant used for general supply. The power for traction purposes would be single phase, 15,000 volts, at 16⅔ frequency. Extensions were also to be carried out to link up Munich with places in the south-east and elsewhere. Germany had more or less standardised her drive on six locomotives, and only one of them was without gears. Among the types used was an individual axle drive which overcame the difficulty of transmitting power from a spring-borne motor to a non-spring-borne wheel, *i.e.*, the Buckley drive, which was also used in Switzerland.

Hungary was now only one-third the size she had been; she had practically no water power and very little coal which could be used for locomotives. Natural oil and gas resources had been incorporated in either Rumania, Czecho-Slovakia, or Yugo-Slavia; Dr. Smith referred to Hungary as being like a head without a trunk. The railways started from Budapest, and did not seem to go anywhere, and it was very difficult for the railways to be worked at all. Something had to be done, however, to make the country independent, and it was anticipated that the difficulty would be solved ultimately in the same way that Austria had solved her difficulty. Hungary was to have a national network, three-phase, at 50 cycles, power being obtained from stations using brown coal, lignite, or peat fuel, which was quite unsuitable for steam locomotives. It would be necessary to supply power to the different railways by split phases along different routes, and to equalise the load as reasonably as possible. On such a system it would not be possible to use the ordinary a.c. commutator motor. The standard a.c. motor for traction work at present was the neutralised-series motor, which had practically ousted every other type; successful working with that type of motor, however, required a low frequency. One reason why some European countries had been so successful with a.c.—perhaps relatively more successful than America—was that they had a low frequency. In Hungary, however, they wanted to use 50 cycles, and for that purpose the a.c. commutator motor was not likely to be a success as a traction machine. They hoped to overcome the difficulty by using what was known in America as the split-phase system. On the locomotive there was a phase converter, which was like an induction motor and was supplied, on one phase, with single-phase current, the induction motors which drove the locomotive being supplied from the three phases of the converter. That system was in use quite successfully in America. Hungary, however, had not gone ahead, first, because of the Soviet revolution and, secondly, on account of financial difficulties.

Northern Italy was described as the cradle of railway electrification in Europe, the Valtellina Railway being the first example of main-line electrification in Europe. When Italy first started, there was practically no other system available than the three-phase system, which entailed a double overhead conductor, but that was its worst disadvantage. The frequency used on the Italian three-phase railways was 15 cycles, for two reasons, namely, that the inductive drop was much smaller, and—perhaps more important—the speed of the motors was more suitable. Gearless locomotives on the Valtellina Railway had proved quite successful. The next line to be electrified in Italy was the Giovi line, which had a very bad tunnel and congested traffic, both of which difficulties were solved by electrification. The Savona-Ceva line, on the Turin route, was another of the early Italian electric railways, after which the Mont Cenis route, with its tunnel, was tackled. He would be a bold man who would say that Italy had not done well with her three-phase system. It had

solved her difficulty of lack of coal and, although at the beginning the locomotives only had two speeds, they were now running with motors giving three and four speeds, and performing admirably. The voltage on the three-phase system had to be kept down to 3,000 and, speaking generally, Dr. Smith said the greatest credit was due to the Italian engineers for the way in which they started before anyone else and developed this successful system of three-phase railways, which, up to the present, had not been replaced. Later developments in Italy included the building of a hydro-electric power station in the Apennines, the problem being so to arrange the power stations that a constant supply of water power could be obtained in both winter and summer. For this purpose the Alpine power stations were linked up with the stations in the Apennines, so that, whereas the summer supply could be taken from the Alpine stations, the winter supplies could be taken from the Apennine stations when everything in the Alps was frozen up. Future work on the Italian railways was being extended into the peninsula itself and, as a standard frequency of 45 cycles had been adopted, it would be possible to obtain power from existing networks, and to use 10,000 volts at 45 cycles, three-phase. A series of slides was shown to illustrate the types of geared and gearless locomotives used on the Italian railways.

The standard system adopted in Scandinavia was a.c. There was working there the most northerly railway in the world, practically within the Arctic Circle, a line built for the transport of the rich minerals in the north of Scandinavia, which included some of the finest iron ore deposits in the world. There was very heavy traffic down to the port of Lulea, on the Gulf of Bothnia, and to Narvik, also on the coast. When the miners' strike took place in Great Britain there was a bad time in Sweden on account of the lack of coal, and the authorities decided to go ahead with the electrification of the Stockholm-Gothenburg Railway. Later the price of coal fell, money was rather scarce, and not very much progress was made with the electrification schemes. A start had been made with a modified scheme recently, however, and it had been decided that the best system for the country was the single-phase system at 15,000 volts, with overhead wires and a 16⅔ frequency. Power would be obtained from stations used for general supply, instead of erecting special stations for the railways, although originally the intention was to have special railway power stations. All the lines in Norway would ultimately be worked single phase. The original locomotives on the mineral line referred to had no gears, and weighed 138 tons each, developing 1,700 h.p. It was necessary to use two of those locomotives for the goods trains, but new ones recently delivered developed 2,900 h.p., and were about 10 tons lighter than the original locomotives.

Switzerland, which, said the lecturer, had probably done relatively the most with regard to railway electrification schemes, was going ahead rapidly, and recently, when the unemployment question became acute and it was necessary to do something to keep the Swiss engineering works busy, the Government hastened the 1933 programme by five years, so that instead of electrifying 100 kilometres per annum, 200 kilometres of route were to be electrified per annum. Moreover, a credit of 60,000,000 fr. was recently passed to enable the work to be carried out. After mentioning well-known electric railways in Switzerland, such as the Bergdorf-Thun three-phase line and the Simplon tunnel line, Dr. Smith made reference to the fact that during the war things became very bad from the point of view of coal supplies, and the traffic in the Rhone valley almost ceased. As a result, the electrification scheme was pushed down to Isella. Then the Loetschberg line was electrified to connect Berne with Italy; otherwise, there was no direct communication. In the Engadine, electrification work was started before the war, and there was the line from Pontresina to St. Moritz, power being obtained from a power station at Brusio, with sub-stations at Bevers. In passing from Italy to Switzerland, one started with the three-phase system, then passed to a d.c. section, and then on to another section which was single-phase. All the previously-mentioned lines were privately owned, but the Federal Railways had been the subject of a good deal of consideration by a special investigatory committee, and it was ultimately decided to recommend the adoption of the single-phase system, with high voltage, overhead contact wire, and low frequency. A number of power stations were being built in connection with the Federal scheme, and Dr. Smith made special mention of the stations at Armsteg and Ritom. Another station, at Barberini, supplies power for the line from Lausanne to Vallorbes, which line was expected to be working by 1928. A series of slides illustrated the various types of locomotives in use in Switzerland, which numbered about 12; no attempt had been made in Switzerland to standardise locomotives. Some were fitted with regenerative equipment, but it did not yield very good results under Swiss conditions. At the very place where regenerative control would be useful, said Dr. Smith, namely, under conditions similar to those of the London suburban traffic, it was most difficult to obtain. On mountain railways it was almost better to use rheostatic braking. In connection with the various types of locomotive, special attention was again drawn to the Buckley drive, slides of the internal details of which were shown; Dr. Smith remarked that, although it did not appear that such a drive could work satisfactorily, in practice it did. The policy of the Federal Railway authorities was to run separate traction plant in general power stations until such time as the railway load developed to the full extent, when special traction power stations would be maintained.

Finally, a brief reference was made to the United States of America, the first line mentioned being the Butte-Anaconda line, running from Harlow Town across five ranges of mountains to Tacona and Seattle, in the north-west. That line, of which some particulars were given before the Institution some time ago by Mr. Welbourn, was unique in using 3,000 volts d.c., and was really part of the trans-Continental route from Chicago to Seattle. The Norfolk and Western Railway was being extended into Virginia, and the lines centred about New York used 650 volts d.c. The New York, New Haven, and Hartford single-phase, 11,000-volt, 25-cycle line was next referred to, it being mentioned that more experimental development work had been done on that line than on any other. Altogether, in the U.S.A., there were nine single-phase railways, three high-pressure d.c. railways, and a fair number of low-pressure d.c. lines. The electric locomotives were working under disadvantages there, because they had to enter New York along the new central line, so that the single-phase locomotives had to be made suitable for working also on d.c. lines—a very poor compromise. The Pennsylvania Railroad Co. had done some d.c. and a.c. work, and its programme was to extend the a.c. system down to Washington. Dr. Smith pointed out that the geared locomotive with reciprocating parts was not now considered in the same favourable way as it was some years ago.

In conclusion, the lecturer said his feeling with regard to the subject of railway electrification was that they ought to know as much as possible about it, because the enormous development on the Continent in connection with hydro-electric power schemes for that purpose might affect this country seriously in two ways. It would, in years to come, decrease the coal exports—a matter of national concern—and, on the other hand, the development of electrification schemes throughout the world opened up an enormous field both for hydro-electric and railway equipment. Personally, he did not think it mattered much what system of electrification was adopted; the great thing was that English manufacturers ought to see what they could do to take part in the great development. Whereas all other countries of the world had definitely settled upon a railway electrification policy, Great Britain was doing nothing.

Discussion.

COLONEL F. A. CORTEZ LEIGH (L.M. & S. Railway) said that there was no doubt that Great Britain was very backward as regarded main-line electrification, but the problems had been studied by different people. The reason they were doing nothing was that they did not see the commercial results which would justify embarking upon such an enormous expenditure at the present time.

MR. G. W. PARTRIDGE (London Electric Supply Corporation) said that, of the ten countries referred to by the lecturer, two had adopted d.c., seven a.c., and in the remaining country both systems had been adopted. The systems which might be necessary in dealing with railway electrification schemes in the British Empire would be different from that required for Great Britain itself. In adopting any particular system, the important point was not the effect upon telephonic communication, of which a good deal had been heard, or the watts per ton mile, or even the efficiency of a particular system, but what was the system which would give the cheapest energy from the source of generation to the drawbar of the train? Was the lecturer quite sure that it was impossible to design a motor that would work reasonably well with both single-phase and direct current? He had seen small motors giving excellent results on both systems.

MR. T. STEVENS said that some 12 years ago he was asked to go to a foreign country and lay out the details for an electric railway to be operated with water power. When he went into the matter he came to the conclusion that, from the financial point of view, it would be very much better to sell the energy generated from water power for other than railway purposes. As a result, he recommended that no railway should be built, but that the whole output of the water-power plant should be sold for lighting purposes in the towns near by. He mentioned that because the electrification of railways was a question of economy. If it were possible to save, as was mentioned in the discussion on the Midland Railway, 24 per cent. on capital outlay, then it was quite worth doing, but if, on the other hand, only 5 per cent. was saved, as had been shown in calculations on another railway, it was much better to invest the money and draw 6 per cent. and not have a mass of electrical plant on hand. In 1910 news came from America that four single-phase railways had been equipped, but that before the expiration of the guarantee period of 12 months the contractors had completely re-equipped them as d.c. lines. That of course, was a great hindrance to progress on single-phase working in America. He had gone to America at that time to see why those railways had been converted to d.c. working, and the sole reason was that the lines had been designed and the plant ordered by men who were not thoroughly acquainted with the electrification problem. That instance was not evidence that single-phase railways could not be equipped in other parts in the same manner as the Norfolk and Western Railway in America had been equipped. That was a line 29 miles long, and was being extended into Virginia. Electricity was obtained from a power station burning coal, it being generated and stepped

up to 33,000 volts for the overhead line. The distribution was extraordinarily economical and the loss, on the average, was only 1¼ per cent.

MR. W. E. HIGHFIELD said that it appeared from the lecture that those countries which had adopted d.c. working took their supply from the 50-cycle general supply of the country, whilst those which had adopted single-phase working used a separate supply on account of the long distances between sub-stations. Those two points were probably the main advantages of the respective systems. One point that was not brought out fully, perhaps, but for which the French people ought to be given great credit, was that they had adopted the d.c. system at 1,500 volts, transforming from the 50-cycle supply, and had put in single-commutator rotary converters at the sub-stations, and also mercury-arc rectifiers. Both those steps were very courageous, and it was gratifying to know that they had been entirely successful. He fancied he had detected a note of regret in Dr. Smith's remarks about the large schemes that were in hand in France, but it might be some satisfaction to know that some of them were being carried out with our money.

DR. PARKER SMITH, who had time for only a brief reply, said that he was not aware that there was a note of regret in his remarks for what the French were doing. The Department of Scientific and Industrial Research had last year, and again this year, made him a grant for a research assistant, to enable him to investigate many of the problems in connection with the work he had been doing at the colleges. The reasons for particular countries adopting particular systems differed a great deal. For instance, on the Norfolk and Western line in America there was no need to bother about the cost of coal, because it was produced on the spot; in that case operating cost was the important thing. In Switzerland, on the other hand, coal was very expensive and none was produced in the country. At the same time, he doubted whether, at the moment, it was cheaper to work the Swiss railways electrically than by steam, but by working railways electrically the Swiss had gained national independence. They had learned during the war what it was to be dependent upon two neighbours who were fighting one another. In Austria the electrification of railways was the only thing to do, because the country had no coal and no money to buy any with. Similarly, Italy had suffered from coal famines. On the other hand, Germany had coal, but it was said that there was too little of it; in any case, a good deal of it was going elsewhere, and by using the central electricity stations of the country—for example, in Silesia—it had been possible to save half the coal consumpton. That was one of the greatest arguments for this country, that it was possible to halve the coal consumption on the railways by electrification.

A Turbine Explosion at Shanghai.

Destruction of a 20,000-kW Machine.

A SERIOUS accident occurred at the Riverside Power Station, owned by the Shanghai Municipal Council, on November 15th last, resulting in the death of three engineers and injuries to a number of men working in the station.

One of the new 20,000-kW turbo-generator sets was undergoing a trial run for balancing purposes, when it suddenly burst, wrecking the whole of the machine. At the time of the test the generator was disconnected, and although it suffered damage, the injury is said not to be irreparable. Part of the rotor was hurled against one of the steel columns of the building, from which it apparently glanced and buried itself in a 6,600-V switchboard which had been erected for controlling the auxiliary plant in the station. This completely wrecked a section of the switchboard, cutting off the supply to the two main circulating water pumps which were supplying the condensers of two 18,000-kW machines running on load at the time. Immediately after the accident, the power house was filled with live steam from the pipe serving the turbine; consequently the whole of the plant had to be shut down, and the supply was not completely restored until some time afterwards.

Describing the appearance of the station after the explosion, the *North-China Herald* says that the turbine was hurled from the 22-ft. high concrete platform on which it had been mounted. Half of the rotor was found in an upright position, the coupling end up, some 40 ft. from its original position, the blades mangled and bent into a mass, beyond repair. The other half, core and blades, was scattered over an area of between 300 and 400 yards radius. The governor control box, weighing about 5,000 lb., was hurled many yards. Above the scene of the wreckage, roof, girders, stays, and other portions of the building were twisted and broken. Apertures several feet in diameter were knocked through the northern wall.

The turbine was manufactured by Messrs. C. A. Parsons and Co., Ltd., and it, or a similar one, was illustrated in our Jubilee Issue (November 17th, 1922) as an example of the capabilities of British manufacturers. It was a reaction turbine designed for steam at 180 lb. pressure, superheated to 572 deg. F., and for an exhaust vacuum of 28.5 in. It was direct coupled to a 3-phase Parsons alternator, with an economical continuous maximum rating of 20,000 kW at 0.80 power factor, 1,500 r.p.m., and a generating pressure of 6,600 V, 50 cycles. A general conception of the size of the set may be obtained from the size of the floor space of the platform upon which it rested. It is between 60 and 70 ft. in length, and from 20 to 25 ft. wide.

The cause of the disaster is obscure, and likely to remain so. The *North-China Herald* says that it is thought that the speed must have abnormally increased, and that the emergency trip valve, the function of which is automatically to shut off the steam in the event of the speed exceeding a certain limit, may have failed to act, a circumstance which permitted the machine to race away. On the other hand, the opinion of "experts," recorded in the same journal, was that the disaster was caused by a fault in the rotor core, that opinion being strengthened by an examination of the severed half. They declared that even if the trip gear had not been in good working order, the shaft would not have split as it did if there had been nothing faulty in it. If the trip gear allowed the machine to revolve at a much higher speed, it might have gone to twice the normal, but the sound would have warned the engineers that it was not functioning properly.

Among those who were killed by the explosion were Mr. J. E. Wilson, switchgear superintendent; Mr. C. W. Donaldson, representative of Messrs. C. A. Parsons & Co., Ltd., who was sent out from England to erect the new plant; and Mr. T. Moodie, a charge engineer. Mr. W. Whitelock, another charge engineer, had to have a leg amputated soon after the explosion.

Legal.

Mullis v. Burlectas, Ltd.

IN the Mayor's & City of London Court, on January 1st, before Judge Shewell Cooper, an action was brought by Mr. Henry F. Mullis, commercial traveller, against Burlectas, Ltd., electricians, 11, Pancras Lane, E.C., for £70 15s. salary in lieu of notice or damages for wrongful dismissal. Mr. Gilbert Stone, who appeared for the plaintiff, said that the question for the Court to decide was whether the plaintiff was entitled to damages because his employment with the defendants as a commercial traveller was terminated by a notice that was too short; or, alternatively, whether he was entitled to damages for wrongful dismissal. The defendants had set up a special defence that plaintiff was only entitled to one week's notice, which he had had, but in the plaintiff's view that was not sufficient. On June 18th defendants wrote to plaintiff confirming an arrangement by which he was to act as commercial traveller for them and to receive a salary of £5 a week, 15s. per week expenses, and when the amount of the orders which he took exceeded £50 a week, he was to be paid commission of 2½ per cent. That arrangement held good for a fortnight until June 30th. It was a trial period for a fortnight certain. When that came to an end there was a fresh arrangement by which the plaintiff went on for an indefinite period on the same terms as to salary and commission. An effort was made to vary it by reducing his salary and increasing the commission, but the plaintiff refused. He was given a week's notice, which he refused to agree to and he now claimed three months' salary in lieu of notice. He was informed that he would be the sole traveller for London and that if other travellers were appointed they would be under his orders. There had never been any suggestion that there was good cause for dismissing him.

Plaintiff was called and he said that the defendants first offered him no salary but a commission of 20 per cent. on orders for electrical standards which he obtained from retail customers, 5 per cent. from wholesale customers, and 2½ per cent. from the shipping trade. He declined that arrangement because he told them he would not work for nothing until he knew what business he could do. He offered to accept £5 a week, 15s. a week expenses and 2½ per cent. commission if it was paid weekly, or 5 per cent. if it was paid monthly. He told Mr. Leck, defendants' managing director, that he was looking for a permanent appointment. When he started taking orders for the defendants he exceeded £50 worth of orders a week on several occasions and on July 24th was paid £6 5s. commission for two weeks. Then when the trial period was over he told Mr. Leck he did not know where he stood and he asked for a proper agreement. Mr. Leck told him no new agreement was necessary, as he was continuing the old agreement. Believing that, he went on working for the defendants without an agreement. Then Dewey, defendants' works manager at Staines, suggested that he should take £2 10s. a week salary to cover expenses and 10 per cent. commission on all orders. He told Dewey that, in the light of past returns, that was not good enough. He rejected that and was told he would go on under the old agreement. Then Chasen, defendants' secretary, told him he had to give him a week's notice, but that he could still continue to act for them if he was content to take £2 10s. a week and 7½ per cent. commission. He declined to take that.

In cross-examination plaintiff said his difficulties were much increased in getting business, owing to the fact that before he went to them defendants had sent electrical standards to hundreds of firms in London on sale or return. It was absolutely untrue that the defendants ever told him he would be a weekly servant, nor did the defendants' secretary tell him that they had forgotten to put into his letter of appointment that it was subject to a week's notice on either side. He was expected to work miracles and to turn sale or return orders into firm orders. It was absolutely untrue that in four specific instances he had sent in orders to the defendants which had never been given. He was too well known in the trade to do anything of that sort. His difficulties were added to because defendants decided to give retailers 50 per cent. As a result of that change the cost of the defendants' electrical standards was put up to a very considerable amount.

For the defence Mr. ALEXANDER LECK, defendants' managing director, said he told the plaintiff he was engaged on a weekly basis. Mr. CHASEN, defendants' secretary, said he told the plaintiff that they had omitted to mention in the letter that the arrangement was subject to a week's notice, and plaintiff then said it was quite unnecessary, as, unless he could get a living out of the proposition, he would not want any notice at all. He gave plaintiff a week's notice but offered him alternative terms.

Mr. RICHARD STRIP (of Harrison & Co.), said he did not give the order attributed to him by the plaintiff. He was supposed to have converted a sale or return order into a firm order. He was not likely to do that seeing that they had the goods on hand for four months and could not sell any of them.

Miss ALDRED (assistant to J. & T. Robinson) said they had not given an order which the plaintiff alleged they had given.

Mr. HERBERT GODFREY gave evidence to the same effect, as did a salesman in the employment of Garsubil, Ltd.

Judge SHEWELL COOPER said he could not find that the defendants were justified in dismissing the plaintiff for misconduct. All sorts of things might have happened with regard to the orders. Plaintiff was practically committing suicide by sending orders which he had not taken at all. There might have been misunderstandings or disinclinations to carry out orders already given and obtained by the skill and honeyed tongue of the traveller. If he found for the defendants he would have to hold that the plaintiff had committed deliberate fraud. Defendants were inviting him to say that the plaintiff was a fraudulent scoundrel and he was not prepared to hold it. He did not accept the evidence that plaintiff was told he would be a weekly servant. He was entitled to a reasonable notice, and in his view he must find for the plaintiff for £30, with costs, for three months' salary, less what he had earned by getting employment elsewhere.

Published Specifications.

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents.

The name of the applicant's patent agent, if any, will be found on the printed specification.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

21,959. "Automatic telephone systems." Siemens Bros. & Co., Ltd., and W. H. Grinsted. August 12th, 1922. (208,194.)

22,014. "Electric relays." J. L. L. Verney. August 19th, 1921. (184,797.)

22,323. "Telegraph systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). August 16th, 1922. (208,196.)

24,065. "Polyphase electric meters." New Antwerp Telephone and Electrical Works Soc. Anon. September 8th, 1921. (185,738.)

24,425. "Electric soldering apparatus for soldering thin steel bands, such as band saws and the like." R. Kapp. September 8th, 1922. (208,204.)

24,823. "Alternating-current dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). September 13th, 1922. (208,222.)

24,870. "Electroscopic method and apparatus for testing the genuineness of woollen and silk materials." A. Bernini. May 27th, 1922. (198,320.)

24,884. "Electric lighting sets." A. H. Railing, C. C. Garrard, and W. Wilson. September 14th, 1922. (208,228.)

25,114. "Electric switches." A. Reyrolle & Co., Ltd., J. Mirrey, and F. N. Linstow. September 16th, 1922. (208,241.)

25,288. "Tramway and electric railway rails." W. Smith, E. W. Hodgson, and J. Wolstenholme. September 19th, 1922. (208,244.)

25,416. "Electrical step-by-step motor systems." Barr & Stroud, Ltd., and J. W. French. September 20th, 1922. (208,246.)

25,660. "Means for suspending shades, reflectors, and the like for electric lamps." Astro Electric, Ltd., and D. M. Colman. September 22nd, 1922. (208,255.)

25,668. "Fixing and protecting lead-covered electric wires." H. Wallace. September 22nd, 1922. (208,256.)

26,095. "Systems of electric motor control." British Thomson-Houston Co., Ltd. (General Electric Co.). September 27th, 1922. (208,264.)

26,329. "Dynamo-electric generators for electric welding." J. H. St. Mawdsley. September 29th, 1922. (Cognate application 13,960/23.) (208,268.)

27,068. "Electric furnaces." L. J. Hancock and T. R. Hancock. October 6th, 1922. (208,282.)

29,076. "Protective arrangements for alternating electric current systems." Electrical Improvements, Ltd., B. H. Leeson, and R. W. Biles. October 25th, 1922. (208,303.)

29,189. "Electromagnetic relay for indicating current-direction irrespective of polarity or strength." L. C. Preston. October 26th, 1922. (208,305.)

29,775. "Signalling systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). October 31st, 1922. (208,313.)

30,493. "Telephone apparatus." L. Schmidt. November 7th, 1922. (208,330.)

30,582. "Rotary electrodes for electric welding machines." S. H. Gordon and Rose Street Foundry Engineering Co., Ltd. November 8th, 1922. (Cognate application 5,359/23.) (208,331.)

30,988. "Automatic electric motor control systems." A. D. Ferguson and Metropolitan-Vickers Electrical Co., Ltd. November 13th, 1922. (208,334.)

31,601. "Electric cables." W. T. Henley's Telegraph Works Co., Ltd., and W. F. Bishop. November 18th, 1922. (208,344.)

31,706. "Methods of and means for impregnating coils." British Thomson-Houston Co., Ltd. (General Electric Co.). November 20th, 1922. (208,345.)

31,722. "Sound-producing device." H. C. Heath. November 20th, 1922. (208,346.)

32,258. "Automatic and semi-automatic telephone circuits." Coventry Automatic Telephones, Ltd., and C. C. Puckette. November 25th, 1922. (208,354.)

32,676. "Switching of circuits for charging accumulators of wireless reception sets." C. Pressland." November 30th, 1922. (208,359.)

33,342. "Electric meters." I. Robotti. December 6th, 1922. (208,365.)

35,094. "Searchlights and other projection apparatus." G. A. Hughes. December 23rd, 1922. (208,388.)

35,191. "Electric switching apparatus." British Thomson-Houston Co., Ltd. December 27th, 1921. (191,048.)

35,249. "Electric signalling systems employing high-frequency carrier waves." Western Electric Co., Ltd. (Western Electric Co. Inc.). December 28th, 1922. (Addition to 170,286 as modified by 196,123.) (208,390.)

35,300. "Heat-resisting stand for electric and other flat-irons." Cape Asbestos Co., Ltd., and W. A. Godfrey. December 28th, 1922. (208,391.)

1923.

350. "Electric starters for internal-combustion engines." K. A. Bareyl and P. Kaemmerer. January 4th, 1923. (208,396.)

930. "Wheel for tramway, railway, and road vehicles." C. J. M. Manon. January 11th, 1923. (208,398.)

1,343. "Miners' electric lamps." W. Gosmann and Concordia Elektrizitäts Akt. Ges. January 15th, 1923. (208,404.)

2,133. "Track-sanding devices for tramway cars and like vehicles." T. Curry. January 24th, 1923. (208,411.)

2,261. "Wireless receiving sets." A. Page. January 25th, 1923. (208,414.)

3,166. "Methods of welding." British Thomson-Houston Co., Ltd. (General Electric Co.). February 2nd, 1923. (208,425.)

4,094. "Electric junction boxes." E. Grierson and J. W. Grierson. February 12th, 1923. (208,432.)

5,367. "Electric lamp, particularly adapted for use as a night pedestal or table lamp." T. Rombach. February 23rd, 1923. (208,439.)

5,847. "Direct-current rotary transformers." A. D. Riccia. April 27th, 1922. (Addition to 172,969.) (196,893.)

6,000. "Crossings of tramway tracks." R. B. Ransford (G. Macairel). March 1st, 1923. (208,442.)

6,010. "Sound-amplifying chambers." A. Sloane. March 1st, 1923. (208,444.)

8,341. "Wireless receiving sets." Western Electric Co., Ltd., G. H. Nash, and B. B. Grace. March 23rd, 1923. (208,460.)

10,297. "Automatically reclosing electric circuit interrupters." Metropolitan-Vickers Electrical Co., Ltd. April 18th, 1922. (196,606.)

12,313. "Device or appliance for use with the head 'phones of wireless telephone sets, and with the receivers of ordinary telephones." J. S. Cattell. May 8th, 1923. (208,476.)

13,533. "Sound reproducing or recording machines." C. Lott. May 22nd, 1923. (Convention date not granted.) (197,967.)

14,171. "Method and means for regulating the degree of vacuum in X-ray tubes." Sir H. Jackson, A. J. Philpot, and British Scientific Instrument Research Association. May 29th, 1923. (Addition to 182,195.) (208,480.)

14,484. "Moulds for reactance coil supports." Metropolitan-Vickers Electrical Co., Ltd. June 16th, 1922. (199,384.)

16,597. "Rectifiers for alternating electric currents." C. E. Ogden. December 26th, 1922. (208,484.)

16,844. "Electric power systems." C. Meyer. June 28th, 1923. (208,487.)

18,990. "Electro-centrifugal separator." A. Marx. August 3rd, 1922. (201,907.)

19,958. "Automatic electric sub-stations." Metropolitan-Vickers Electrical Co., Ltd. August 15th, 1922. (202,626.)

22,066. "Bonding devices for metallic-sheathed electric cables." J. Bryce and Callender's Cable and Construction Co., Ltd. November 6th, 1922. (Divided application 205,709.) (208,496.)

22,629. "Combined wireless and phonographic or like sound-reproducing machines." Marconi's Wireless Telegraph Co., Ltd. September 9th, 1922. (203,710.)

26,323. "Telephone systems." Western Electric Co., Ltd., and L. Polikowsky. August 8th, 1922. (Divided application on 206,578.) (208,501.)

28,048. "Coil holders for wireless signalling systems." Igranic Electric Co., Ltd., A. H. Curtis, S. R. Wright, and A. H. Mackley. August 8th, 1922. (Divided application on 21,601/22.) (207,771.)

Addition to a Large American Station.—A new set of 50,000-kW capacity is to be built for Hell Gate Station of the United Electric Light & Power Co. by the Westinghouse Electric & Manufacturing Co. The turbine is to be cross-compound, with a maximum capacity of 56,250 kW. The two generators will give 62,500 kVA, three-phase current at 13,200 V, 60 cycles. The high-pressure turbine will contain an impulse wheel and Parsons reaction blading with conical boring. The low-pressure turbine will be straight double flow with Parsons reaction blading, conical boring, the last row of blading being of the Baumann type with stream-line exhaust. Strictly speaking, the set will have no bedplate, being mounted on special levelling chucks fitted directly to the steel work of the foundation. It will be operated as a single unit, the terminals of both generators being always coupled together. In starting, both elements will come up to speed together, necessitating only one synchronising operation. There will be no governor on the low-pressure turbine with the exception of an over-speed device, the governing being done at the high-pressure turbine. The high-pressure turbine will also be fitted with an over-speed governor, which, by means of oil pressure, can be tested at or below normal speed.

The turbine room at Hell Gate contains two 40,000-kW Westinghouse, two 35,000-kW General Electric, and two 2,000-kW Westinghouse sets.—*Power.*